SEPTEMBER
1953

MECHANICAL ENGINEERING

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ASME Fall Meeting — Rochester, N. Y., October 5-7, 1953

Steam is literally the lifeblood of our American economy. Through it, the energy in our store of fuels is made available in useable form. Steam has always been taken for granted because it's cheap. But, with the depletion of top grade coals, with the increase in price of fuels generally, and with increasing construction and operating costs, major engineering concentration is required on the problem of . . .

keeping steam cheap

FOR THE WORLD'S MOST EFFICIENT ELECTRIC GENERATING UNIT

—The Cyclone Furnace

All power plants make kilowatts; here's one that's making history!

The entire nation will benefit when American Gas & Electric Service Corporation ushers in a new era of power progress with the installation of its revolutionary new steam-electric generating system at the Philo Plant of the Ohio Power Co., near Zanesville, Ohio. For the first time, boiler engineers will break through steam's critical pressure barrier to achieve unprecedented 5500 pounds pressure and 1150 F steam temperature. The new boiler and turbo-generator unit will produce 120,000 kw—three times the power in the same space as the system it replaces—and will use 45 per cent less coal per kilowatt-hour.

To fire B&W's unprecedented boiler, the Cyclone Furnace—in itself an outstanding development in coal-burning technology—has been chosen to provide maximum combustion efficiency and economy.

The Cyclone represents a vast simplification of the entire mechanism of preparing and burning coal—and, in one easy step, effectively solves the bothersome question of fly ash handling and emission from the stack. A high percentage of all bituminous coals in the United States can be burned efficiently in the Cyclone Furnace. It can handle a wide variety of coal from mines in all parts of the country. Regardless of where a coal-burning plant may be located; it will have an excellent competitive market in which to purchase coal suitable for firing in the Cyclone Furnace.

We will be pleased to discuss the Cyclone Furnace in terms of your specific public utility or industrial requirements and to submit data on the Cyclone's many advantages of particular benefit to you. The Babcock & Wilcox Company, 161 East 42nd St., New York 17, N. Y.

N-157

BABCOCK & WILCOX

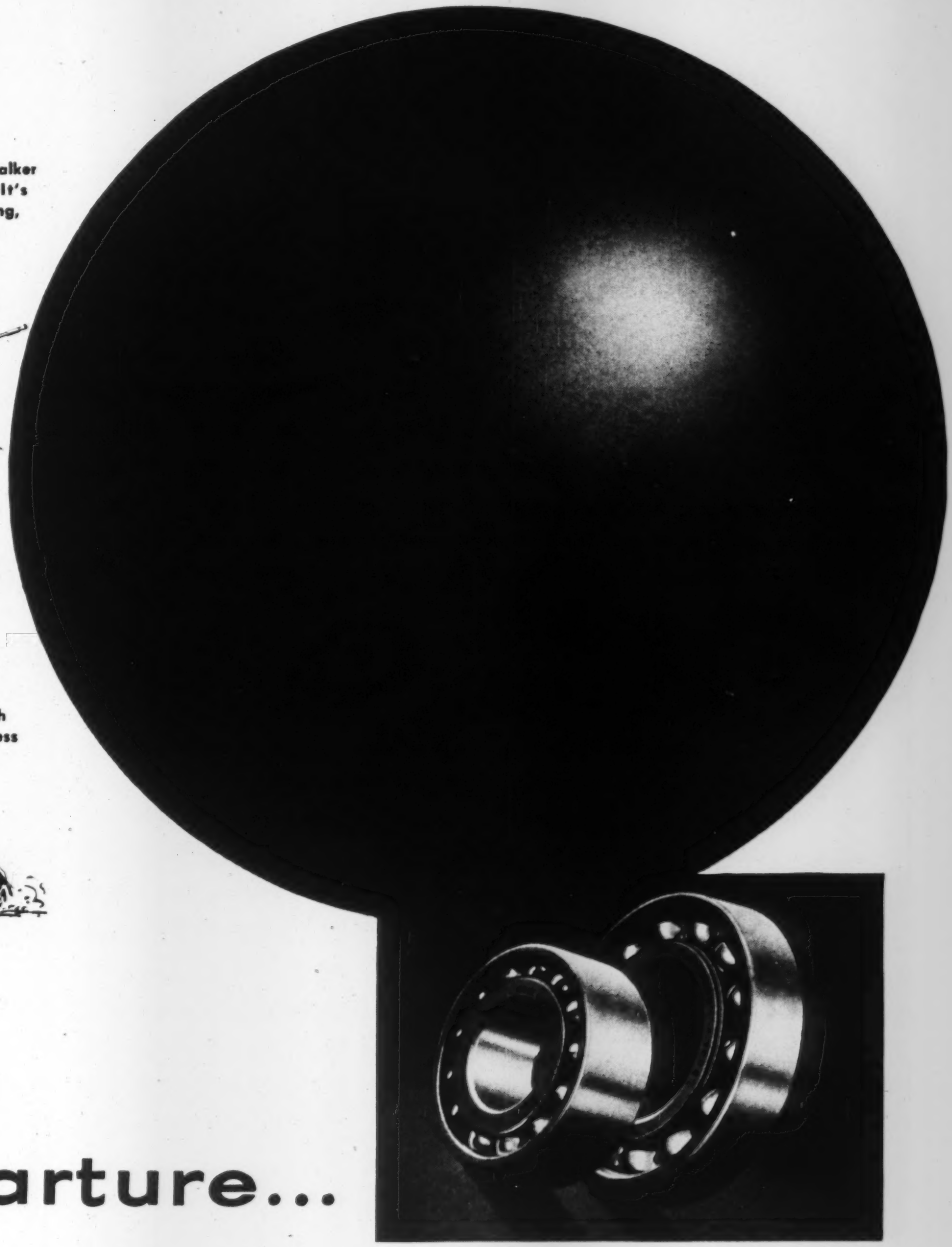
BOILER DIVISION

new speed

Watch that Walker Bulldog roll! It's the hardest-hitting, swiftest-striking tank of its type!

new agility

Twenty-six tons of armored fury, yet the Walker turns at a touch . . . has matchless maneuverability!



New Departure...

The Walker Bulldog is unequaled for ease of control—thanks to its CD-500 transmission, developed by Allison Division of General Motors. The CD-500 makes the driver's job much easier by hydraulically performing the functions of steering, shifting and braking.

In such an intricate mechanism, thousands of inter-connected moving parts must be supported with *sustained accuracy and rigidity*. This is the job performed by New Departures in many bearing applications in the CD-500. New Departures locate shafts in perfect alignment, and gears in exact pitch-line contact, under both radial and thrust loads. They maintain this accuracy without need for adjustments or time-wasting service.

In all transmissions, New Departures assure longest life . . . lowest frictional losses . . . maximum power output.

NOTHING ROLLS LIKE A BALL

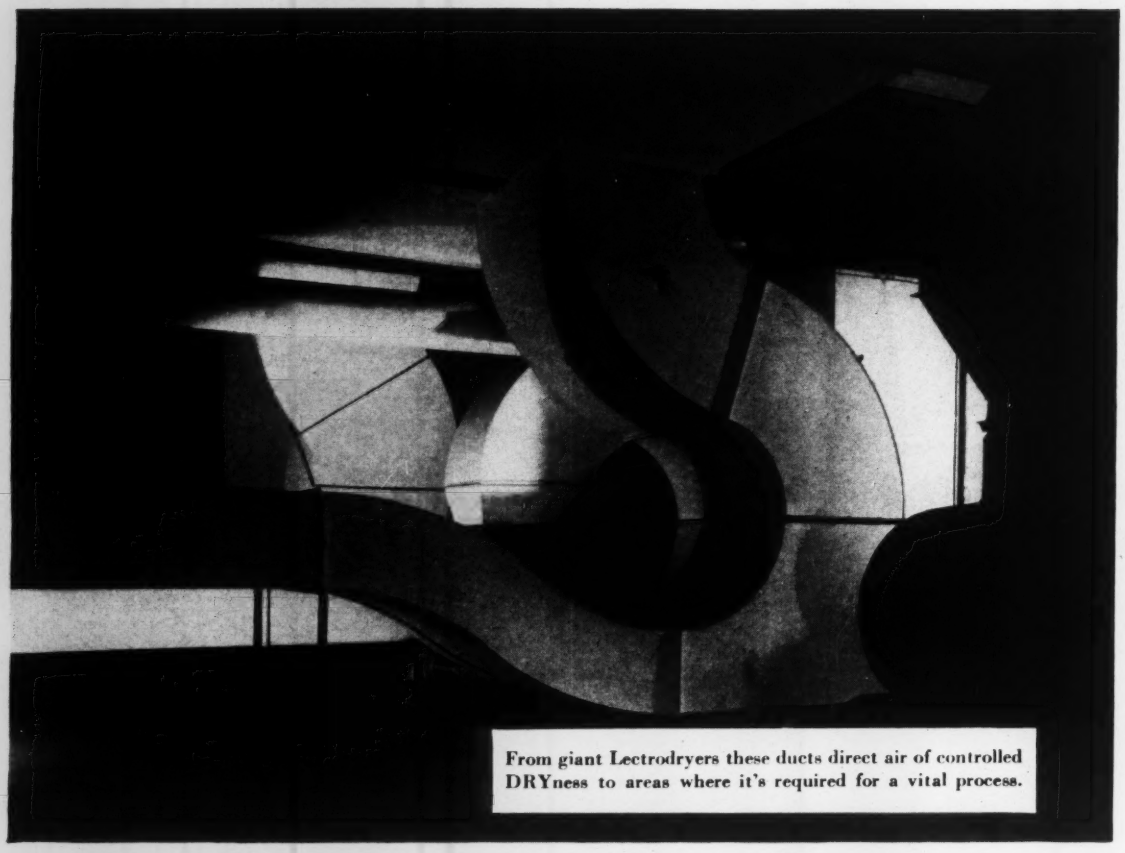
NEW DEPARTURE

BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

Also Makers of the Famous New Departure Coaster Brake

MECHANICAL ENGINEERING, September, 1953, Vol. 75, No. 9. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢. to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.



From giant Lectrodryers these ducts direct air of controlled DRYness to areas where it's required for a vital process.

. . . Of 24 chemical majors cited by *Fortune*,

20 are long-time Lectrodryer* users

because . . .

1. **Lectrodryers DRY organic liquids in volume to a moisture content as low as 3 or 4 parts per million.**
2. **Lectrodryers DRY air and gases in small or large volume to a dewpoint as low as -110° F.**

Fortune Magazine's half-century study of the chemical industry looks like a "Who's Who" of Lectrodryer customers. Of 24 leading chemical companies named, 20 have used Lectrodryers for years. They learned long ago to depend on Lectrodryers for controlled DRYness.

Lectrodryers remove the hard-to-get moisture which could upset a process or cause an unwanted reaction. Placed on stream in a chemical process, Lectrodryers deliver air, gases and organic liquids free of contaminating moisture. In work areas and warehouses, Lectrodryers are DRYing atmospheres to 10% relative humidity.

Data Available—A free booklet, *Because Moisture Isn't Pink*, describes Lectrodryers, their function and applications. For a copy, write Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.

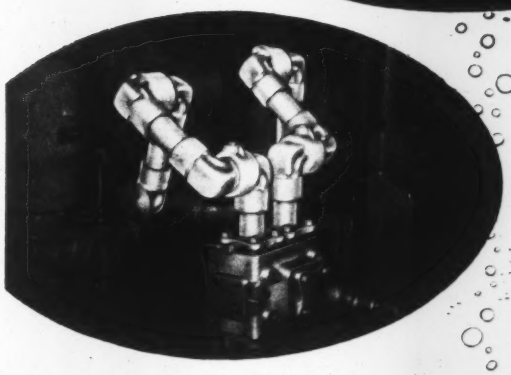
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.

Safety of its people and property, plus increased efficiency and economy of operation, were the chief considerations which turned Johnson Motors to Chiksan Swivel Joints.



Chiksan ball-bearing swivel joints installed on Lester-Phoenix die-casting machine helped Johnson Motors meet its fluid cost problems.

Johnson Motors die-casting department, one of the largest in the Middle West — and the largest captive plant in this country — selected Chiksan hydraulic swivel joints when it converted its machines from flammable oils to nonflammable hydraulic fluids.

Forty-eight package die casting machines are operated on a staggered three shift basis, producing more than 400 aluminum alloy die castings ranging from ½ ounce to 11 pounds in size. Hydraulic systems are operated at pressures up to 2000 psi, with average total die forces in the range of 300 to 500 tons. Castings are made at temperatures between 1100° and 1200° F.

Chiksan ball-bearing swivel joints have helped to reduce fluid losses from 40,000 gallons per year to 10,000 gallons. In contrast to former loss of from 1 to 3 gallons in repositioning bolted lines, Chiksan joints permit resetting of table level with virtually no fluid loss. Time consumed in resetting table levels has been reduced from 2 men and 1 hour to one man and 15 minutes of time.

This story is typical of the many ways thousands of manufacturers are using Chiksan ball-bearing swivel joints for greater safety, efficiency, and economy in their operations.

For Safety, Economy and Efficiency in your die casting department Chiksan has plans and applications worthy of your immediate and serious consideration.

Write CHIKSAN Engineering Research Division today for our NEW Catalog No. 53-C, Dept. ME-9.

The Flow of Enterprise Relies on **CHIKSAN**

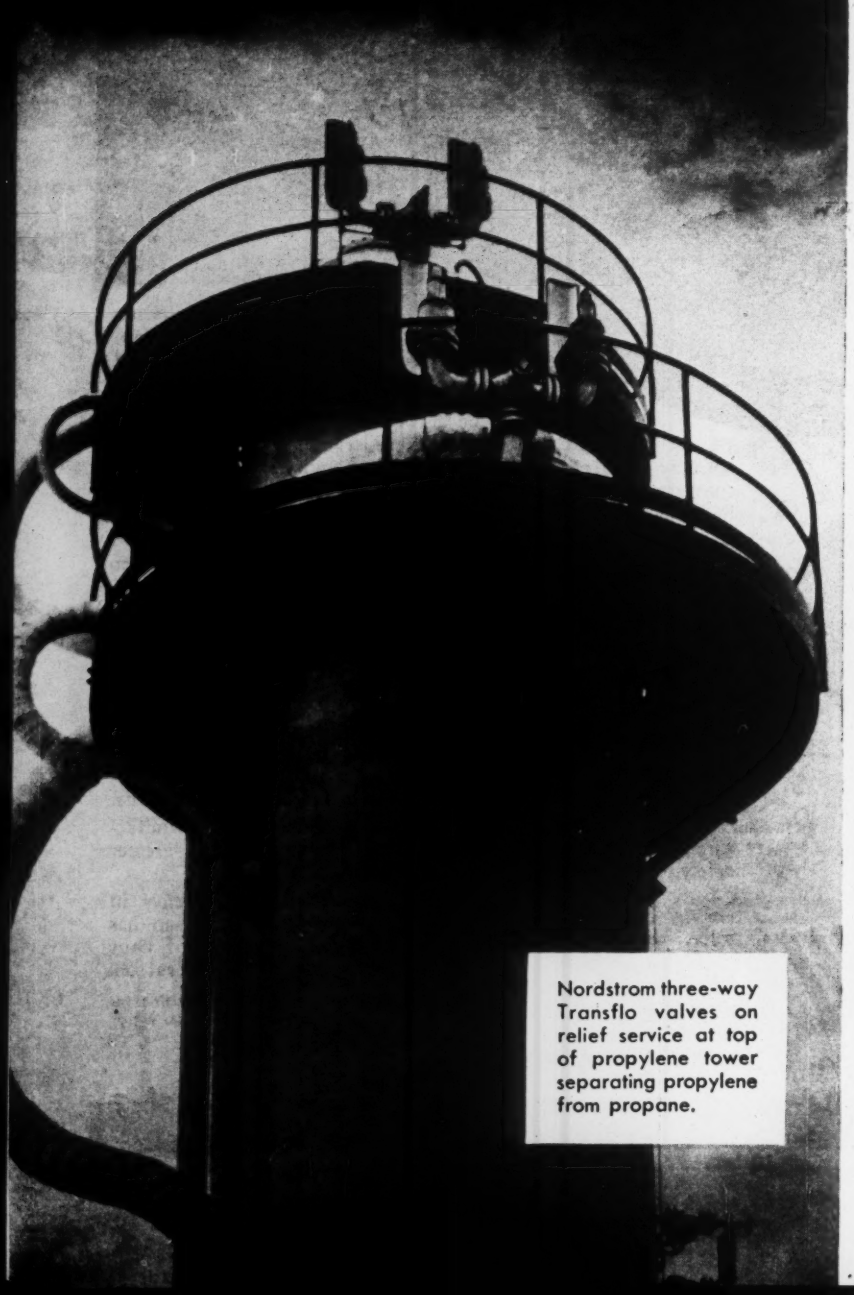
CHIKSAN TRADE MARK REG.

Representatives in Principal Cities

Ball-Bearing Swivel Joints

THESE TWO EXAMPLES SHOW YOU

What Nordstrom Means by "Lubricaut



Nordstrom three-way Transflo valves on relief service at top of propylene tower separating propylene from propane.

TYPICAL NORDSTROM REFINERY APPLICATIONS

- Catalytic Polymerization
- Crude Topping and Vacuum Distillation
- Fluid Catalytic Cracking and Gas Recovery
- Distillate Recovery in Cycling Plants
- Duo-Sol Solvent Extraction
- Houdriflow Catalytic Cracking and Gas Recovery
- Light Ends Fractionating
- Thermal Cracking
- Phenol Extraction
- Propane Deasphalting
- Cycloversion
- Delayed Coking
- Girbotol Process
- Propane Dewaxing
- Hydroforming Process
- Naphtha Polyforming
- Solexol Process
- Solvent Dewaxing
- Thermal Reforming

Nordstrom has compiled a series of specification sheets for each of these processes, showing recommended materials, pressure classes, lubricants and valve figure numbers. Ask your Nordstrom sales engineer to review them with you.

TYPICAL NORDSTROM PROCESS INDUSTRY APPLICATIONS

- Beverage Plants
- Cement Plants
- Chemical Plants
- Explosives
- Food Plants
- Gas Plants
- Ice and Refrigeration
- Paint and Lacquer
- Paper and Pulp
- Pharmaceuticals
- Power and Steam Plants
- Rubber Plants
- Sewage Plants
- Smelters and Mines
- Soap Factories
- Steel Mills
- Sugar Refineries
- Synthetic Ammonia
- Synthetic Fibers
- Synthetic Plastics
- Synthetic Rubber
- Tanneries
- Textiles and Dyes
- Water Works

The new Nordstrom Corrosion-Resistant Valve Bulletin V-217 will make it easy for you to fit the right valve to each service. Write for a copy, Rockwell Manufacturing Company, Pittsburgh 8, Pa., or ask your Nordstrom sales engineer.

-Sealed for POSITIVE SHUT-OFF"

Here are two typical Nordstrom valve process applications—one is a propylene tower, the other a dry hydrogen line.

They illustrate an important point in specifying valves for process service . . . if really tight shut-off of hard-to-hold gases or fluids is important, no valve can do the job better than Nordstrom.

Why? Because Nordstrom is the original lubricated plug valve. Nordstrom is the valve with the extra seal of plastic lubricant around the valve ports to check seepage of even the lightest, most penetrating substances.

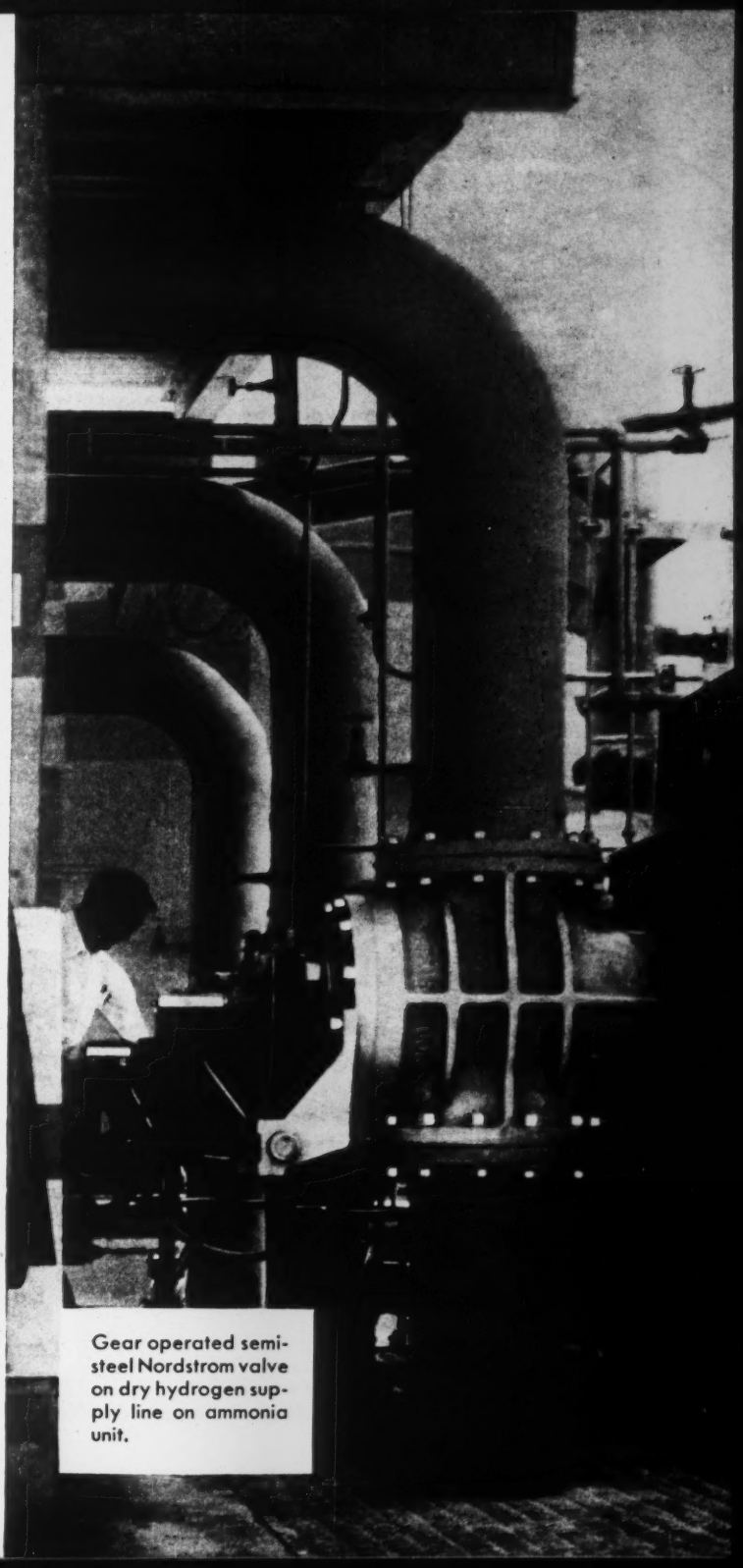
That, of course, means greater safety, and greater economy, too, because when leakage is prevented, valve life is far longer. And most important, it means uninterrupted operation of continuous process units—no down-time for avoidable valve repairs.

The same lubricant that seals, also keeps the valve ready to operate in an emergency.

Nordstrom valves are built in a wide range of sizes, pressures, special metals and body designs for the process industries, including three- and four-way designs for batching, blending and switching. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

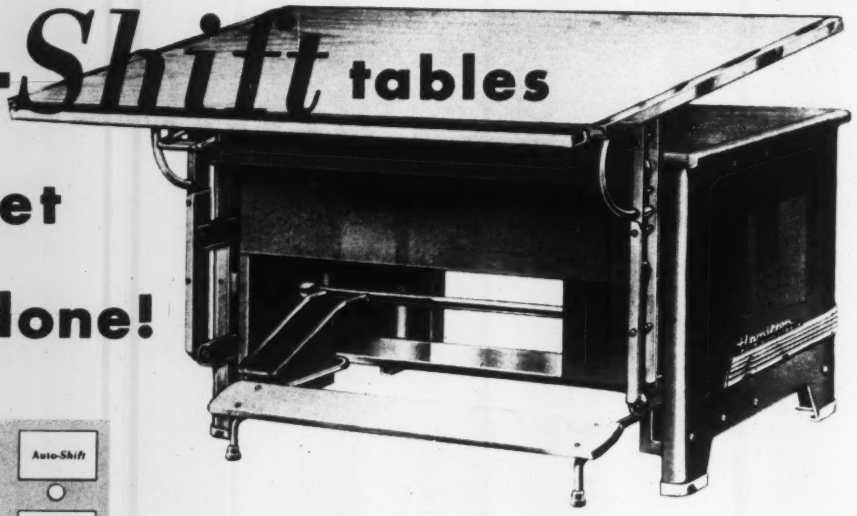
ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

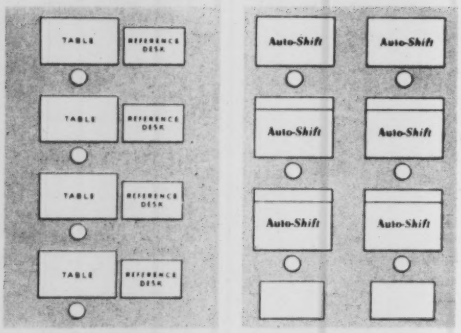
Another Rockwell Product



Gear operated semi-steel Nordstrom valve on dry hydrogen supply line on ammonia unit.

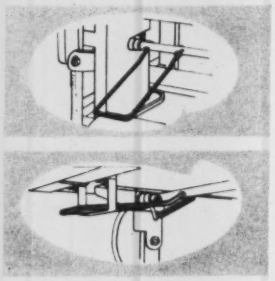
Auto-*Shift* tables help get the work done!





HEIGHT ADJUSTMENT

SLOPE ADJUSTMENT



30-50% greater floor space efficiency

Approximately 250 sq. ft. of floor space accommodates *two more* Auto-*Shifts* than board-next-to-desk tables. Space efficiency *and* operating efficiency are greater, since Auto-*Shift* puts large reference surface directly behind each draftsman—instantly, effortlessly accessible.

Greatly reduced draftsman fatigue

Auto-*Shift* provides rapid, simple adjustment of both board height and slope—permits draftsmen to change working position frequently. Convenient foot release frees top for height adjustment—hand release permits rapid slope adjustment. Fully counterbalanced top moves effortlessly.

Excels in row installations

Auto-*Shift* efficiency reaches a peak in row installations. Each draftsman has a full-size extension reference surface directly behind him, generous drawer space immediately at hand. Everything is where he needs it to work quickly and accurately. Auto-*Shift* helps get the work done!

Here is the complete Auto-*Shift* story

Get all the Auto-Shift facts, including new range of sizes, data on new models for use at front and rear of row installations. Write for your copy today.

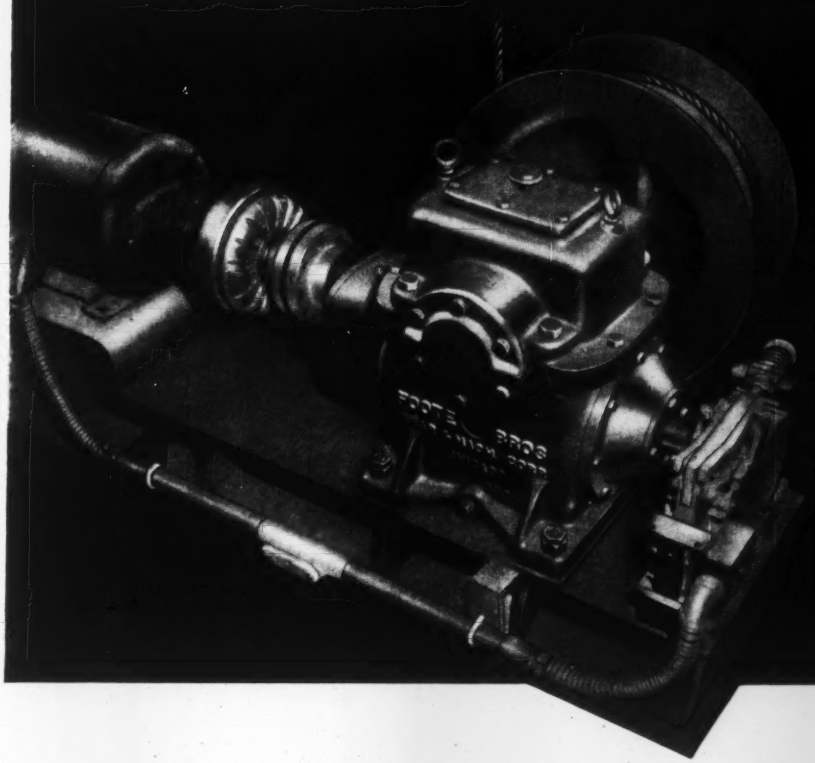
Drafting Equipment Division

Hamilton Manufacturing Company

Two Rivers, Wisconsin

TOUGH JOBS MADE EASY...

WITH FOOTE BROS. HYGRADE DRIVES... MORE STAMINA IN LESS SPACE



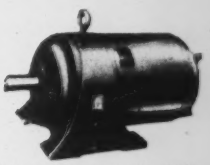
Horizontal Hygrade Drive operating door-control cable of open hearth furnace at Fairless Works, United States Steel Corporation. For purposes of illustration, safety guard over coupling has been removed.

Steel making is a rugged, 'round-the-clock job. And Foote Bros. Hygrade Drives have the stamina for such typical, tough service — like this Hygrade at U. S. Steel's Fairless Works.

Sturdy, compact Hygrade Drives are built especially for heavy-duty applications — ratios range up to 4,108 to 1, capacities up to 260 h.p. But Enclosed Hygrade Drives are also designed to meet area limitations — modern, space-saving housings have been engineered around new-process, high-efficiency worm gearing to assure maximum performance in minimum space.

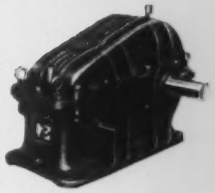
For optimum load-carrying capacity — for maintenance-free operation — for day-after-day service under the most rugged conditions... select Foote Bros. Hygrade Worm Gear Drives. There's a complete line — a size and type to meet all your requirements. Available with either horizontal or vertical output shaft. For special applications, Vertical Hytop Hygrade provides a long, extended, output shaft without additional support. For prompt delivery, call your Foote Bros. representative or write for bulletin.

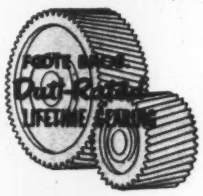
Line-O-Power Drives



Foote Bros.-Louis Allis Gearmotors

Maxi-Power Drives





This Trademark Stands for the Finest in Industrial Gearing

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
4545 South Western Boulevard • Chicago 9, Illinois

Foote Bros. Gear and Machine Corporation
Dept. Q, 4545 South Western Blvd., Chicago 9, Illinois

Please send Bulletin HGB. I understand it contains full information on Hygrade Drives.

Name .....

Position .....

Company .....

Address .....

City ..... Zone ..... State .....

FOR YOUR TESTING PROGRAM

HAGAN

INSTRUMENTS AND CONTROLS

For the past thirty-five years, the engineers of Hagan Corporation have designed and placed in operation systems of automatic control and instrumentation to fulfill the requirements of thousands of projects. These have ranged from simple pressure controls to the complex systems of controls and instruments required for the largest aeronautical testing facilities.

As a result of such long experience and augmented by an extensive research and development program, the engineers of Hagan's Aeronautical and Special Products Division are able to choose exactly the type of equipment best suited to the particular problem. They can use pneumatic, hydraulic or electronic components, singly or in combination. Hagan recording, indicating and integrating instruments, pneumatic or electric signal transmitters, and a complete series of Hagan Control devices are available for combining into systems which will achieve the desired results.

Our clients include the leading aeronautical testing facilities of numerous governmental agencies, company research laboratories, United States Air Force testing facilities, metallurgical and process industries and prominent aeronautical and automotive manufacturers.

We will welcome the opportunity to demonstrate how Hagan engineers can render valuable assistance in implementing your program of modernizing or extending your testing program facilities.

These outlines of typical installations of Hagan control and instrumentation are a partial indication of the scope of activities of our Aeronautical and Special Products Division.

Plant No. 1

A system of instrumentation and automatic control has been installed in connection with a steam turbine driven blast furnace blower. The system measures the air delivery from the blower, correcting the measurement automatically for air temperature and barometric pressure, and adjusts the turbine speed so that blower is maintained at the set point.

Plant No. 2

Two separate gas flows are measured by elements located in a single meter housing. A combining coupling operates a pneumatic transmitter which sends a signal to control valves, and automatically maintains a definite ratio between the two flow rates. This ratio is manually adjustable.

Plant No. 3

Portable thrust stands, using the Hagan ThrusTorq, are in regular use for checking total thrust available in either jet or propeller driven planes. The air output signals from the ThrusTorq units present an exact picture of the engine performance.

Similar ThrusTorq units are also used in the largest permanent thrust stand built to date. This stand will accommodate any plane from the smallest fighter to the largest bomber.

Plant No. 4

Hagan automatic controls were selected to maintain pressure and flow conditions for one of the first supersonic wind tunnels in this country.

Plant No. 5

For one aircraft manufacturer, we have provided instrumentation for measuring mass flow of air, with continuous automatic compensation of the meter for temperature and pressure factors. This equipment provides a record of "corrected" mass flow, as well as indications of the summarized "correction" factor and of the uncorrected flow reading.

Similar equipment is used for true velocity measurements.

Plant No. 6

For a testing facility for jet engine components and accessories, a system of automatic control has been placed in service to maintain simulated flight conditions. The system is actuated from a Hagan program controller, having a manually adjustable time cycle. Test conditions simulate flight from sea level to 60,000 feet altitude, and returning to sea level.

Plant No. 7

Exhausters operating in series or in parallel are controlled for maintaining pressure ratio and pressure compensated surge point.

HAGAN CORPORATION

AERONAUTICAL AND SPECIAL PRODUCTS DIVISION

HAGAN BUILDING, PITTSBURGH 30, PA.

Ford has installed DRAVO *Counterflo* Space Heaters in 17 of its parts depots

In planning the heating system for 17 of its parts depots in various parts of the country, Ford Motor Company wanted to:

1. Keep floor areas free for maximum storage
2. Heat large warehouse areas
3. Provide uniform heat throughout the area

Typical of the Dravo *Counterflo* Space Heaters installed by Ford is the one illustrated at its Cleveland Parts Depot. Dravo Heaters provide:

ADAPTABILITY—Dravo Heaters are mounted horizontally on overhead girders, 16 ft. above the floor, saving valuable storage space and allowing maximum use of the floor area.

PENETRATION—Dravo Heaters' high-capacity fans re-circulate the air completely throughout the 140,560 sq. ft. area in 25 minutes, despite the tiering of material in uneven heights. Directional louvres guide the flow of air. The area can be warmed quickly in winter and cooled easily in summer.

ECONOMY—Dravo Heaters are thermostatically controlled to keep temperatures constant. Installation cost was kept to a minimum, because no ductwork was required. Minimum efficiency is 80%. Roof heat losses are low.

These and many other advantages can be yours when you install Dravo *Counterflo* Space Heaters in your commercial or industrial building. Write for complete details. Use the coupon.

DRAVO
CORPORATION

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DRAVO

Send me information about heating for the subjects I've checked, and Dravo Heater Catalog QR 523-2435.

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- ☐ Stores, schools and auditoriums.
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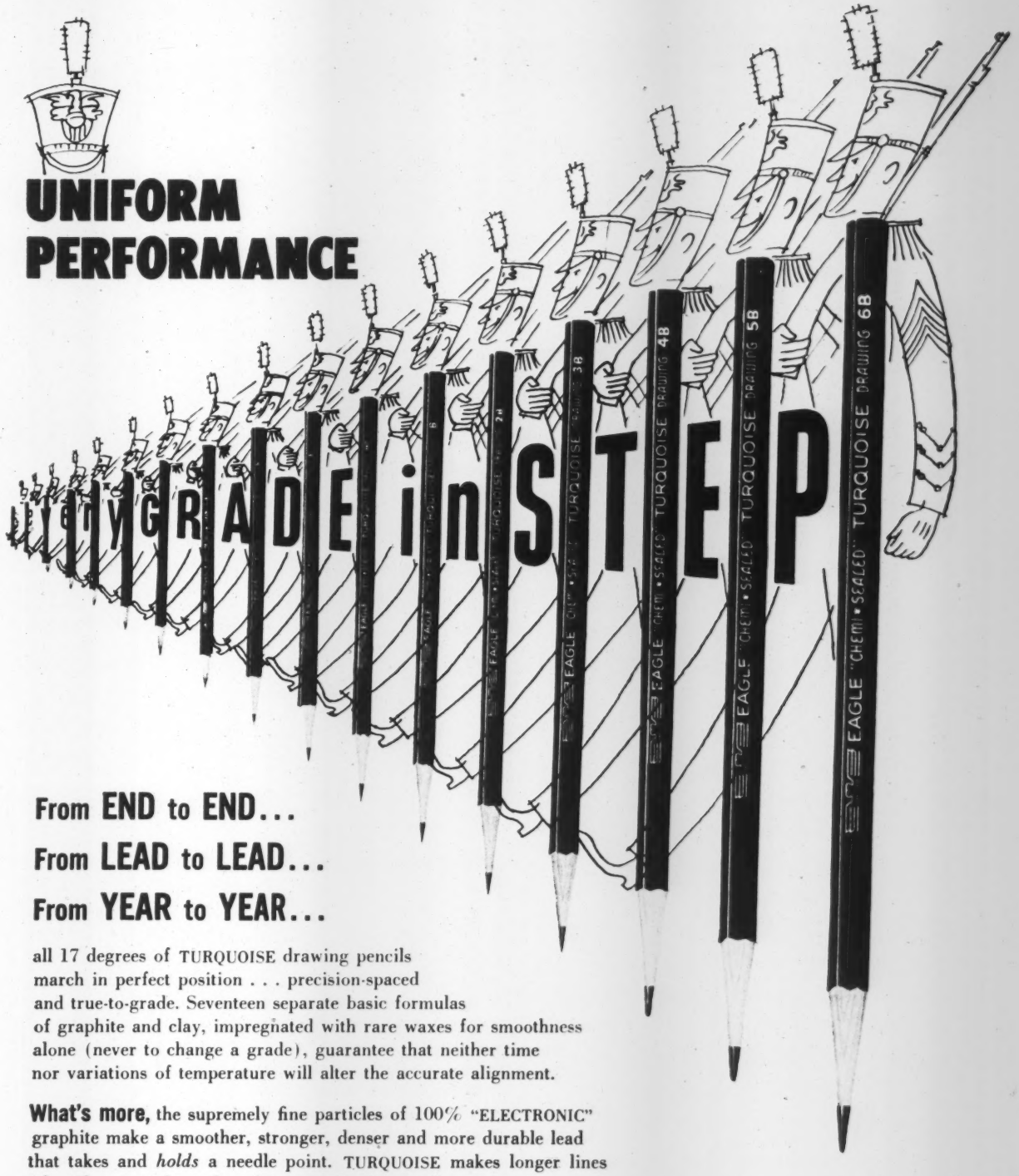
- ☐ Tempering make-up air.
- ☐ Temporary heating.
- ☐ For use in conjunction with air conditioning.
- ☐ Please have a representative call at no obligation to me.

Name_____ Title_____
Company_____ Address_____
City_____ Zone_____ State_____


EAGLE "CHEMI-SEALED" TURQUOISE DRAWING 6B
EAGLE "CHEMI-SEALED" TURQUOISE DRAWING 5B
EAGLE "CHEMI-SEALED" TURQUOISE DRAWING 4B
EAGLE "CHEMI-SEALED" TURQUOISE DRAWING 3B

UNIFORM PERFORMANCE

...GRADE in STEP

From END to END...

From LEAD to LEAD...

From YEAR to YEAR...

all 17 degrees of TURQUOISE drawing pencils march in perfect position . . . precision-spaced and true-to-grade. Seventeen separate basic formulas of graphite and clay, impregnated with rare waxes for smoothness alone (never to change a grade), guarantee that neither time nor variations of temperature will alter the accurate alignment.

What's more, the supremely fine particles of 100% "ELECTRONIC" graphite make a smoother, stronger, denser and more durable lead that takes and *holds* a needle point. TURQUOISE makes longer lines of uniform weight and perfect reproduction quality.

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with 100% *"Electronic" Graphite

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SEND FOR FREE SAMPLES

Just drop us a note, naming the degrees you desire and the dealer who supplies you.

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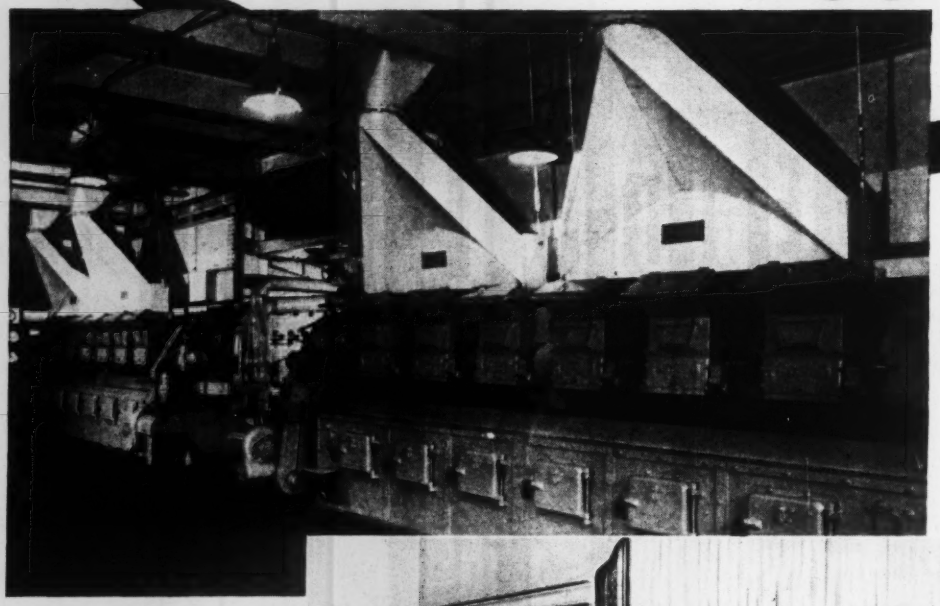
New York • London
Toronto

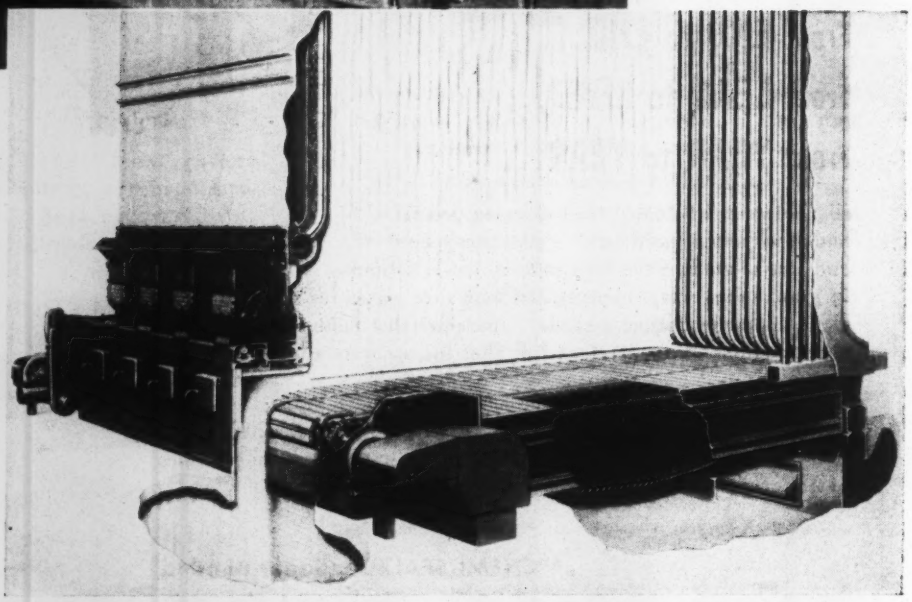
Detroit Rotograte Has You Need



Typical installation of Detroit RotoGrate Stokers in prominent Midwestern Plant. Units designed for capacities of 150,000 pounds of steam per hour each.

Cut-away view of a typical water cooled furnace of a steam generator. Two feeders are removed to show the specially designed overlapping grate that moves slowly forward to continuously discharge the ash at the front. A scientifically designed reinjection system provides effective furnace turbulence.

Detroit RotoGrate Stokers may be applied to all types and makes of boilers or steam generators, and are available for capacities up to 400,000 pounds of steam per hour per unit.



DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities

The Features in a Stoker:

- **Burns any Bituminous coal or Lignite.**
- **Requires no special fuel preparation.**
- **Exceptional fuel economy.**
- **Low auxiliary power.**
- **Increased capacities due to higher burning rates.**
- **Responsive to fluctuating loads.**
- **Continuous ash discharge eliminates intermittent cleaning.**
- **Coal feed, air supply and ash discharge are automatically controlled.**
- **Air for combustion may be preheated.**
- **Availability high—Maintenance low.**

Hundreds of such RotoGrate installations have been made since first introduced by us in 1938. Repeat order customers are best evidence of satisfactory performance.

Do you need more steam? If so, investigate and order your Detroit Stokers now. Whether you are an old or new customer, we are at your service. Write for catalog.

There is a type and size of Detroit Stoker for every Industrial or Commercial need.

DETROIT ROTOGRATE STOKER

REPRESENTATIVE INDUSTRIAL ROTOGRATE USERS

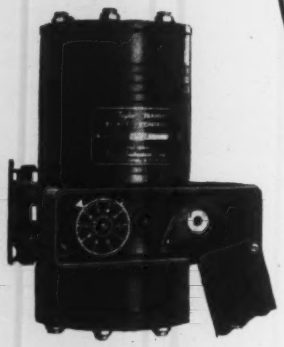
- *Abitibi Power & Paper Co., Ltd.
- *Allied Chemical & Dye Corp.
- *Amalgamated Sugar Co.
- *American Crystal Sugar Co.
- American Cyanamid Co.
- American Distilling Co.
- American Steel Foundries
- Campbell Soup Co.
- Capitol City Products Co.
- Carborundum Co.
- *J. I. Case Co.
- Certain-teed Products Corp.
- Chesapeake & Ohio Railway Co.
- Chicago & Northwestern Railway Co.
- *Chrysler Corp.
- Clinton Industries, Inc.
- *Consolidated Paper Co.
- *Peter Cooper Corps.
- Crane Co.
- Crucible Steel Co. of America
- Cudahy Bros. Co.
- E. I. DuPont de Nemours & Co.
- Elliott Co., Inc.
- Falk Corp.
- *General Electric Co.
- *General Motors Corp.
- Goodyear Tire & Rubber Co., Inc.
- *Great Western Sugar Co.
- Hoberg Paper Mills, Inc.
- Illinois Central System
- Interlake Iron Corp.
- Jeffrey Mfg. Co.
- Jones & Laughlin Steel Corp.
- Kimberly-Clark Corp.
- *Libby-Owens Ford Glass Co.
- *Eli Lilly & Co.
- *Minnesota Mining & Mfg. Co.
- *Monsanto Chemical Co.
- *Nash-Kelvinator Corp.
- *New York Central System
- *Northwest Paper Co.
- Pabst Brewing Co.
- Pacific Mills
- *Pullman Standard Car Mfg. Co.
- Quaker Oats Co.
- Rochester & Pittsburgh Coal Co.
- *Rohm & Haas Co.
- Schmidt & Ault Paper Co.
- *Studebaker Corp.
- *Sutherland Paper Co.
- Tennessee Coal, Iron & Railroad Co
- *Tennessee Eastman Corp.
- United States Gypsum Co.
- United States Rubber Co.
- *Walworth Co., Inc.
- Western Electric Co., Inc.
- Wilson & Co., Inc.
- *Wyman-Gordon Co.

*Repeat Order Plants

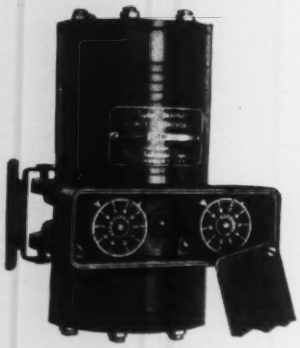
SEE TAYLOR

at the ISA Show — Booths 131, 132, 133

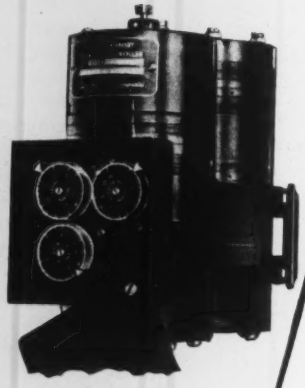
PLUG-IN CONTROLLERS



The One-Knob BI-ACT Controller is designed for use in industrial processes with short time lags, such as close-coupled liquid flow, fast pressure and comparable temperature problems. Combines simplicity of adjustment and economy.

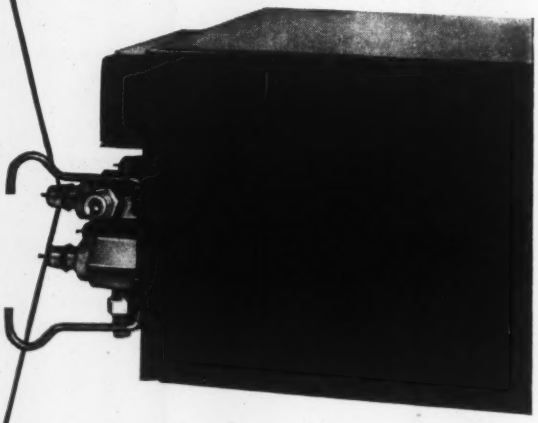


The Two-Knob BI-ACT Controller will cover the full range of reset rate and proportional response adjustments. This makes it more satisfactory for those jobs that have longer time lags, and where close response adjustments are essential to good performance.



The Brand New TRI-ACT Controller combines all 3 response adjustments (gain, reset rate and Pre-Act response). It is the most complete controller, giving the very best control on the more complex processes, particularly those with long time constants, and load changes requiring both derivative and reset adjustments. Gives faster recovery on load changes; start-up without overpeaking; the benefits of automatic reset without its evils.

We'll be demonstrating Taylor versatility on a full size graphic panel section. You will see how the exclusive TRANSET* Plug-In feature enables the process engineer to quickly select or change both controllers and receivers to meet requirements as they develop. He can use the One Knob or Two Knob BI-ACT* or TRI-ACT* Controllers, depending on the control



HERE'S WHAT *VERSATILITY* MEANS TO YOU!

1. You can plug in shop-adjusted instruments.

2. You can efficiently analyze process difficulties by quickly substituting a recorder for an indicator.

3. You can switch from the simplest to most complete controller in a matter of seconds.

4. Down time is kept to a minimum, since both controllers and receivers plug in.

5. Maintenance is unnecessary in the area of

TAYLOR INSTRUMENTS

VERSATILITY

quality required or conditions encountered; he can switch, in seconds, from an indicating to a recording receiver, with or without automatic-to-manual features, or with cascade (pneumatic set) features. In other words, second thinking is both practical and economical.

Both Controllers and Receivers are designed to take advantage of the speed of response and high accuracy of the TRANSAIRE* transmitters —for temperature, pressure or differential pressure.

Be sure to see us at the show! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*

*Trade-Mark

the panel. Checking can be done in the shop where full facilities are available.

6. One standard panel cut-out (5 $\frac{1}{32}$" x 4 $\frac{5}{32}$") accommodates 12 different forms of recording and 11 different forms of indicating receivers.

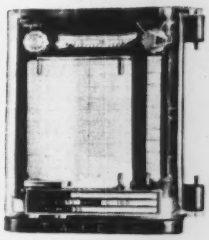
7. You conserve panel space without impairing maintenance facilities.

8. Self-purging case for all receivers is especially appreciated in corrosive or dusty atmospheres.

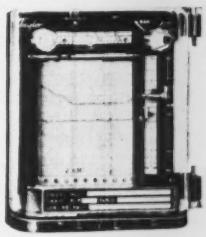
9. Your plant can be kept running smoothly, without expensive shutdowns.

PLUG-IN RECEIVERS

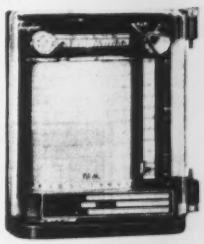
The TRANSET Indicator has all the features of the TRANSET Recorder, but gives no chart record. Gives direct indication of both set point and process variable on single, easy reading 3 $\frac{1}{2}$" dial. *Mounts in same size panel opening as TRANSET Recorder.*



The TRANSET Recorder has automatic-manual unit, remote set-point indicator. 30 day linear chart, 3 hours visible. Chart reads from left to right on rectilinear coordinates, as an engineer would normally plot variables for study.



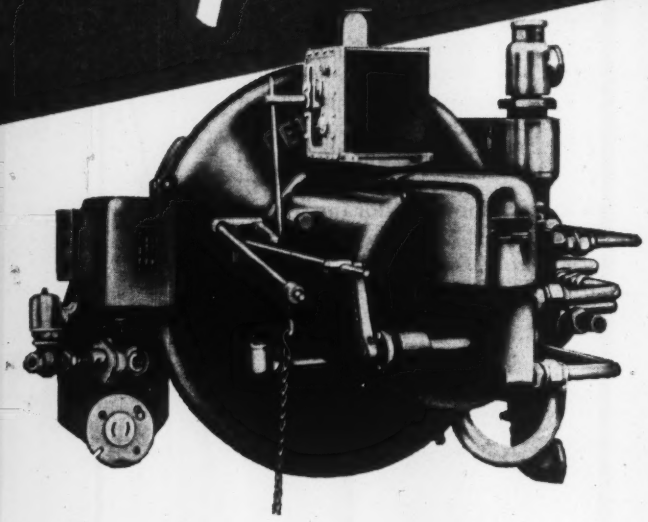
The Single Duty Bi-Record Receiver can record a related variable in addition to that under control. For example, in flow measurement it records static pressure as well as differential pressure.



The Pneumatic Set Receiver (Cascade) combines in *one* case without additional panel space the facilities for pneumatic set, automatic control and automatic-to-manual feature.

MEAN ACCURACY FIRST

steam problem?



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HERE'S WHAT YOU NEED

You need to CUT STEAM COSTS

A Petro industrial oil burner will do it! The Petro burner is designed to burn low-cost heavy fuel oil with high efficiency and complete reliability. Saves money year after year.

You need to CUT LABOR COSTS

A Petro oil burner will do that, too! Completely automatic, it regulates itself without constant attention; frees attendants for other duties.

You need to MEET FLUCTUATING STEAM DEMANDS

A Petro industrial oil burner does just that! The fire can be modulated to meet the most extreme requirements of varying steam loads.

You need to do all this AT LOW COST without replacing your present boiler equipment.

Petro industrial oil burners and combination oil-gas burners are your best buy! They operate with high efficiency in practically every type of boiler.

Petro oil burners have world-wide acceptance. Their dependability is traditional. They are recommended by leading heating contractors everywhere. Fifty years in oil firing gives the Petro organization an exceptional degree of engineering experience and practical "know how."

Petro's outstanding ability to burn heavy, low-cost oils with maximum efficiency has reduced fuel costs in thousands of plants and buildings.

See Petro section in Sweet's Architectural File, or write for catalog and specifications to Petro, 3177 W. 106th St., Cleveland 11, Ohio.

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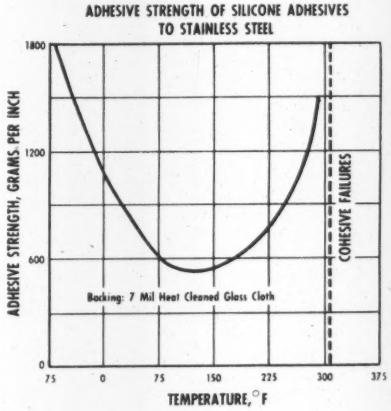
DOW CORNING

Silicone News

Vol. I, Number 1 • PUBLISHED BY DOW CORNING CORPORATION, MIDLAND, MICHIGAN

New Pressure Sensitive Silicone Adhesives Stick To Most Surfaces; Retain Their Excellent Adhesive Strength From -55F To Over 250F

The newest products to come out of our development laboratories are pressure sensitive silicone adhesives that stick to almost any materials including silicones and Teflon. Adhesive strengths in the range of 1800 grams per inch at —55 F and over 1200 grams per inch at 265 F, are far superior to those of conventional pressure sensitive tapes. The adhesive strength between a stainless steel surface and glass tape coated with silicone adhesives is plotted against temperatures ranging from —75 to 285 F in this Figure.



Uses for tapes coated with silicone adhesives include high temperature electrical and electronic applications; weather and moisture resistant wrapping and sealing tapes for low temperature applications. One electrical equipment manufacturer is already using these pressure sensitive adhesives to bond mica matt and integrated mica to glass cloth. *No. 1*

Silicone-based Aluminum Paints Outlast Organic Finishes 10 to 1 at Sterilizing Temperatures

Trays containing vials of aureomycin and other antibiotics at the Lederle Laboratories Division of American Cyanamid Company are loaded onto racks and sterilized for 3 hours at 446 F to destroy pyrogens.

The organic aluminum finish on these racks began to crack and peel, permitting rust to form, after 9 to 15

(continued page 2)

Flexible Silastic* Tubes Carry Air at 500 F; Prevent Engine Failure Due to Icing Over Jet Air Scoops

Reinforced with stainless steel braid, Silastic tubing requires minimum space; endures heat and high frequency vibration.

It was discovered shortly after certain jet engines were put into service that the formation of ice over air intake scoops could choke off the air supply and cause engine failure.

The obvious solution to this problem was to pipe air at 500 F from the compressor to the scoops. But that simple solution involved many problems.

The jet engines were so tightly fitted in their nacelles, that very little room was left for hot air ducts of any kind. High frequency vibration set up by the engine and plane introduced the problem of fatigue failure.

This was a job for a flexible tubing, a tubing that could carry hot air without melting, withstand the vibration and permit fast and easy assembly and disassembly. Engineers of the Aeroquip Corporation of Jackson, Michigan, solved the problem with flexible Silastic tubing. Reinforced with stainless steel braid, Silastic tubing is light and flexible. It is held mechanically to the stainless steel braid so tightly that the tube will not collapse even when subjected to a vacuum.

The high temperature problem of attaching a fitting to the hose was ingeniously solved by the new Aeroquip "Little Gem" fittings. The total assembly proved to be so effective that these anti-icing hoses have become standard equipment.

Despite internal and external temperatures as high as 500 F, the Silastic hoses are still in excellent condition after hundreds of hours of service. Aeroquip has supplied thousands of them to jet manufacturers. From 5 to 20 are required per engine, depending upon its design.

The usefulness of Silastic in this application confirms data collected by our development engineers on effects of accelerated aging at high temperatures on the properties of Silastic. Heat resistant organic rubber becomes brittle in a few hours; Silastic 80 does not crack on flexing over a ⅜ inch mandrel, and hardness increases only 9 points after more than 670 hours of continuous aging with all surfaces of the test sample exposed in an air circulating oven at 480 F.

Silastic 80 readily meets SAE-ASTM Specification TA805 which requires that it have a minimum tensile strength of 500 psi; a minimum ultimate elongation of 50 percent. After 70 hours aging in an air oven at 450 F, increase in hardness is not more than 15 points; drop in tensile strength is less than 25 percent and loss of ultimate elongation, less than 40 percent.

In oil resistance tests, decrease in hardness is less than 45 points; increase in volume, less than 60 percent after 70 hours immersion in ASTM No. 3 oil at 300 F. After 70 hours immersion in ASTM No. 1 oil at 300 F, loss in tensile strength and ultimate elongation is less than 20 percent; decrease in hardness,

(continued page 2)

*T. M. REG. U. S. PAT. OFF.

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MORE

DOW CORNING SILICONE NEWS PUBLISHED BY DOW CORNING CORPORATION

NEW DEVELOPMENT AND TECHNICAL DATA

For copies of any of the publications reviewed in this column or for data relating to any of the articles printed in this issue of the Dow Corning Silicone News, simply circle the corresponding reference number on the coupon below.

Expansible resins. Two new silicone resins, Dow Corning XR-543 and XR-544, can be expanded to produce heat-stable, non-flammable, unicellular foams with densities from 8 to 24 lbs per cubic foot. Highly resistant to thermal shock, these silicone foams show practically no structural or dimensional change after 20 hours at 700 F. Weight loss after 220 hours at 570 F is less than 2%; moisture absorption less than 0.05% after 7 days at 96% RH. Resins are easily foamed in place, made up as sandwich structures or machined with wood working tools. *No. 5*

•

Dow Corning 1109, a durable new silicone water repellent treatment for leather footwear, gloves, luggage and sporting goods; minimizes water absorption and transmission; improves resistance to oils and chemicals without changing the "breathing" characteristics of leather. *No. 6*

•

Now available, the new **1953-54 Reference Guide** to Dow Corning Silicone Products summarizes properties and applications for commercially available silicones. A complete revision of previous guide which some designers have reported to be one of the most helpful catalogs ever produced. *No. 7*

•

Silastic 6-127 paste, an excellent cloth coating material and bonding agent for silicone rubber, retains good dielectric properties over a wide range of temperatures and frequencies. It has superior resistance to heat and moisture; remains flexible down to —100 F. *No. 8*

•

"Tall Tales and Fabulous Facts" is a new 24 page booklet built around the idea that, in our times, the tallest tales are told in technical terms. In this publication, the tall tales our ancestors told about such legendary characters as Paul Bunyan, Davy Crockett and Pecos Bill are related to some equally fabulous facts about Dow Corning silicone products. *No. 9*

•

Air drying silicone water repellent for application to glass, plastic and ceramic insulator bodies and to electronic parts and components maintains high surface resistivity under humid conditions; minimizes adhesion of dirt and chemical dust; reduces maintenance. *No. 10*

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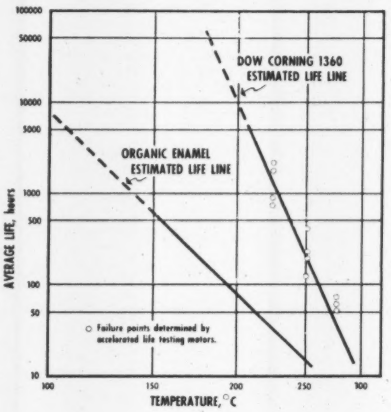
Small Electric Machines and Electronic Parts Can Now Be Designed to Operate at 180 C.

Life and reliability can be increased, or the size and weight of electronic devices and fractional or miniature motors can be reduced through the use of bare magnet wire insulated with Dow Corning 1360 Wire Enamel.

Flexibility, scrape hardness and dielectric strength compare favorably with those of the best organic wire enamels. Dow Corning 1360 coated wire also shows superior resistance to a wide variety of solvents, oils, and salt water.

The results to date of the accelerated life testing at temperatures in the range of 200 to 275 C of several electric motors wound according to standard commercial procedures with 1360 coated wire are plotted in the chart at right. These data show that motors wound with magnet wire insulated with Dow Corning 1360 Wire Enamel have a life in the range of 1500 hours at 225 C (437 F), compared with 30 hours for identical motors wound with the best grade of Class A wire.

Based on the results to date of this motor test program, we expect that the life of machines wound with 1360 coated wire at 180 C will be comparable to that of identical machines wound with conventional Class A wire at their maximum operating temperature of 105 C.



Extrapolating from the data plotted above, we find that the life expectancy at 180 C of magnet wire insulated with this new enamel is in the range of 50,000 hours compared with 200 hours for wire insulated with the best organic enamels. *No. 4*

SILASTIC *continued*

less than 15 points. It shows no shrinkage and swell is less than 20 percent.

After 168 hours immersion in water at 158 F, swell is less than 10 percent and decrease in hardness is less than 10 points. It does not become brittle on continuous exposure at —65 F.

Silastic 80 offers another advantage in that it can be blended with Silastic 50 to fabricate parts having any Shore hardness between 50 and 80. These stocks can be blended to fabricate parts that meet SAE-ASTM Specification TA604. Heat-stable pigments can be used to give these stocks almost any desired color.

In electrical applications such as wire covering and cable coating, Silastic 80 retains excellent dielectric properties over a wide range of temperatures and frequencies. Cable insulated with Silastic 80 has a dielectric strength of 450 volts/mil at 50 C; 430 volts mil at 250 C. *No. 3*

PAINTS *continued*

hours of such service. That introduced a costly hazard because any bit of rust or paint chips in a tray could cause rejection of a whole rack of carefully prepared antibiotics.

Some time ago, the racks were sand blasted, sprayed with a silicone-based aluminum paint. So far, the silicone finished racks have endured 150 hours at sterilizing temperatures with no sign of deterioration. As a result of that experience, Lederle is now using silicone-based paint to refinish sterilizing equipment throughout their plant.

At temperatures in the range of 500 to 1000 F. silicone-based aluminum finishes are used to protect stacks, exhaust mufflers, dryers, and furnaces. Modified silicone enamels in a wide variety of colors are used to protect appliances such as stoves, space heaters and incinerators at temperatures in the range of 400 to 700 F. *No. 2*

First in Silicones
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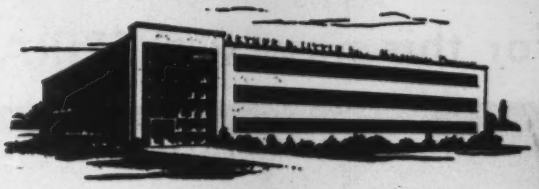
Silicone Electrical Insulating Varnishes
Silicone Molding Compounds
Expansible Silicone Resins
Silicone Defoamers
Silastic



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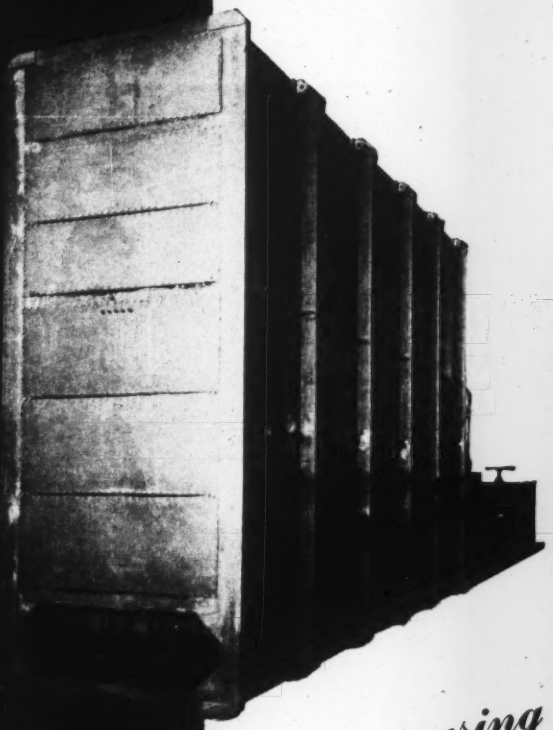
. . . using advanced Engineering Techniques



LIQUID OXYGEN PLANT

An unusual 10 ton/day, liquid oxygen generator was developed and built for the United States Air Force. This prototype plant was designed for simple disassembly for air transportability, where small size and light weight are major objectives. It utilizes the low pressure expansion turbine and reversing exchanger principles.

If lack of personnel has halted development of your new ideas or new products, the ADL Mechanical Division can take over and bring them to complete maturity.

Arthur D. Little, Inc., has blended its scientific and engineering skills in the Mechanical Division to provide industry with a unique service . . . prototype development of equipment requiring a high level of engineering. Scientists in the fields of chemistry, physics, metallurgy, mathematics, biology, electronics and technical economics can be called on as required.

Our staff is experienced in interpreting the ideas of industry and following through with the perfection of specialized equipment.

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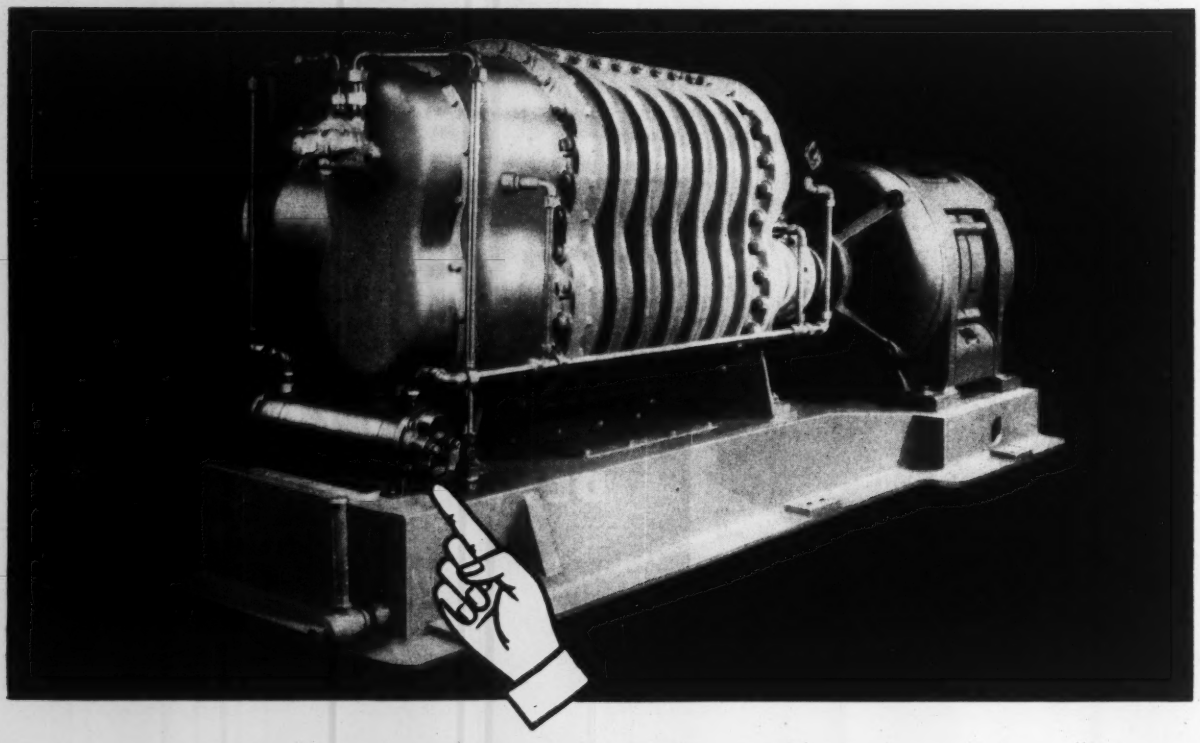
PAST EXPERIENCE

determines the lube oil cooler choice for this new R-C SPIRAXIAL COMPRESSOR



ROSS EXCHANGERS

New in design and new in principle, within its range, this new Roots-Connersville Spiraxial Compressor has been introduced to bridge the gap between conventional Rotary Positive and Centrifugal Compressors.

To provide this new unit with safe, dependable lube oil cooling, Roots-Connersville Blower, a Division of Dresser Industries, Inc., furnishes a Ross Type BCF Exchanger. The "reasons why" are quite natural. Roots-Connersville rotary gas boosters and multi-stage centrifugal blowers have been Ross Exchanger equipped for years. *What better basis for selecting a component than first hand experience?*

. . . And just as past performance makes Ross Exchangers the logical choice as lube oil coolers here, so too have they become the logical choice of other leading manufacturers to safeguard temperatures in engines, speed increasers, turbines, pumps, torque converters and the like.

Equally important to machinery and equipment builder is the ready availability of enduring copper and copper alloy Ross Type BCF Exchangers in a wide range of fully standardized designs pre-engineered to meet most requirements.

For more information, write for Bulletin 1.1K5.

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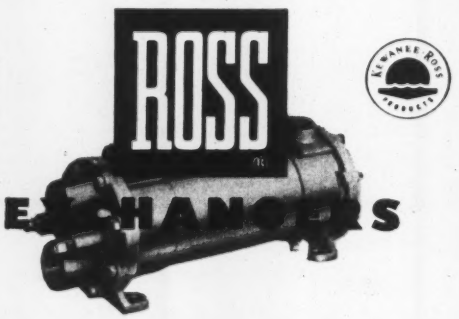

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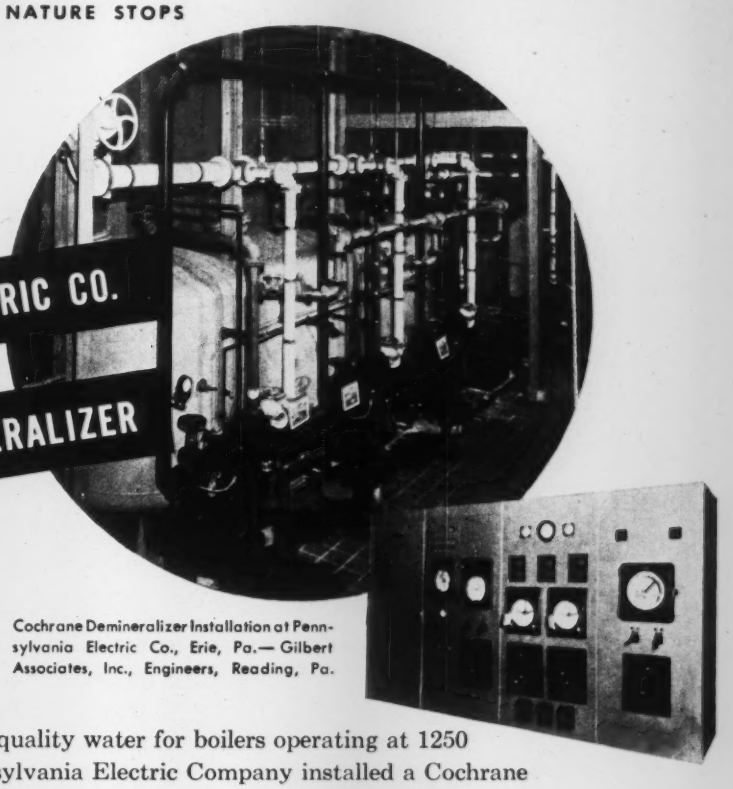
STARTS WHERE NATURE STOPS

AT PENNSYLVANIA ELECTRIC CO.
IT'S A COCHRANE DEMINERALIZER



Cochrane Demineralizer Installation at Pennsylvania Electric Co., Erie, Pa.— Gilbert Associates, Inc., Engineers, Reading, Pa.

• To supply high quality water for boilers operating at 1250 P.S.I.G. the Pennsylvania Electric Company installed a Cochrane Automatic Demineralizer in their Erie, Pa. Power Station. Designed for silica removal, this unit handles 400 GPM in preparing make-up for the boilers.

Demineralization is one of many "water problems" Cochrane's engineers solve every day. Water softening, dealkalization, and deaeration are others—all complex—all requiring expert and specialized knowledge. Whether for process or boiler feed water Cochrane can supply the answer to your particular problem, backed by 90 years' experience in solving industrial water conditioning problems. You'll be sure of unbiased recommendations because Cochrane designs and builds all types of water conditioning equipment.

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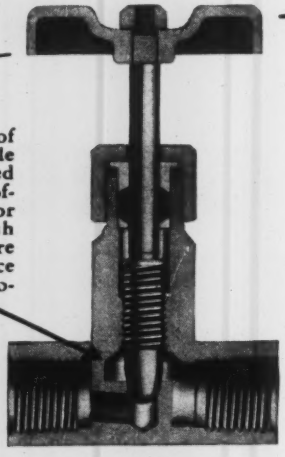
for water, oil or gas

- Body and stem guide extra heavy bar stock fused into one piece.
- Valve stem 416 stainless steel.
- Packing special one-piece "Marpak" moulded ring.
- Bodies marked in accordance with MSS regulations.



ONE PIECE

The stem guides of conventional needle valves are screwed into bodies—this often causes leakage or blow-outs. Marsh Needle Valves are fused into one-piece by exclusive "Conoweld" process.

Introducing-

The Ultimate in Needle Valves

Here is one of the crowning achievements of Marsh research, design, and manufacturing skill. It is the first needle throttling and shutoff valve to combine *all* of the qualities called for today in this highly critical and ever broadening field.

It is a valve that has strength and safety to spare . . . rated for pressures up to 10,000 psi—equally efficient in the lower ranges. A product of Marsh instrument-making and valve manufacturing experience, it combines instrument-like precision with the ruggedness that distinguishes all Marsh valve specialties.

The illustrations tell the story of new thinking; new standards. Body and stem-guide are machined from extra-heavy carbon steel bar stock. Still greater strength and rigidity are achieved by fusing the stem-guide into the body. The complete fusion of guide and body is accomplished by the exclusive Marsh "Conoweld" process.

There are two big advantages to this one-piece construction: (1) It eliminates the danger of unscrewing the valve from the body when opening—a frequent cause of leakage, even dangerous blow-outs (2) It permits perfect line-up of threads and seat. As a result, Marsh valves are easier to operate even at high pressures.

The precision-machined stem is 416 stainless steel. Stem threads are fine pitch for extra strength and fine, controlled regulation. Notable advancements are special "Marpak" one-piece, non-binding longer-lasting packing; deep thread chambers, keeping inlet and outlet piping away from ports and contributing excellent flow characteristics. Entire packing nut and packing gland are electro-zinc plated, preventing corrosion and giving the valve a handsome, plated exterior. The rugged malleable handle is finished in heavy baked enamel.

The new needle valve line includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾" and 1". Also globe and angle valves with male inlet and female outlet in sizes ¼" and ½". *Complete stock carried at our Skokie, Illinois factory and also at our branch plant in Houston, Texas.*

Write today for catalog giving complete details.

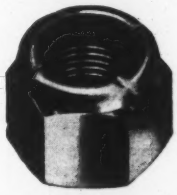
MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
Dept. 29, Skokie, Ill.
Export Dept., 3501 Howard St., Skokie, Ill.

MARSH

"THE STANDARD OF ACCURACY"

self-locking fasteners

Elastic Stop nuts



HEX NUT

SPLINE NUT

HIGH TENSILE NUT

CLINCH NUT

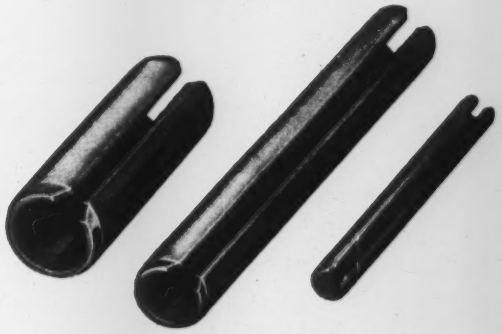
1200° F. HIGH-TEMP. NUT

GANG CHANNEL NUTS

FLOATING ANCHOR NUT

Every major aircraft now being assembled relies on the vibration-proof holding power of ELASTIC STOP nuts. Only ESNA manufactures a complete line of all types and sizes of self-locking nuts.

Rollpins



dia. from 1/16" to 1/2"

Rollpins are slotted, tubular steel, pressed-fit pins with chamfered ends. They drive easily into holes drilled to normal tolerances, compressing as driven. Extra assembly steps like hole reaming or peening are eliminated. Rollpins *lock* in place, yet are readily removed with a punch and may be reused.

Cut assembly costs by using Rollpins as set screws, positioning dowels, clevis or hinge pins. Specify them in place of straight, serrated, tapered or cotter type pins.

ESNA TRADE MARK

ELASTIC STOP NUT CORPORATION OF AMERICA

ROLLPIN TRADEMARK

Mail Coupon for Design information

Elastic Stop Nut Corporation of America
Dept. N34-911, 2330 Vauxhall Road, Union, N. J.

Please send me the following free fastening information:

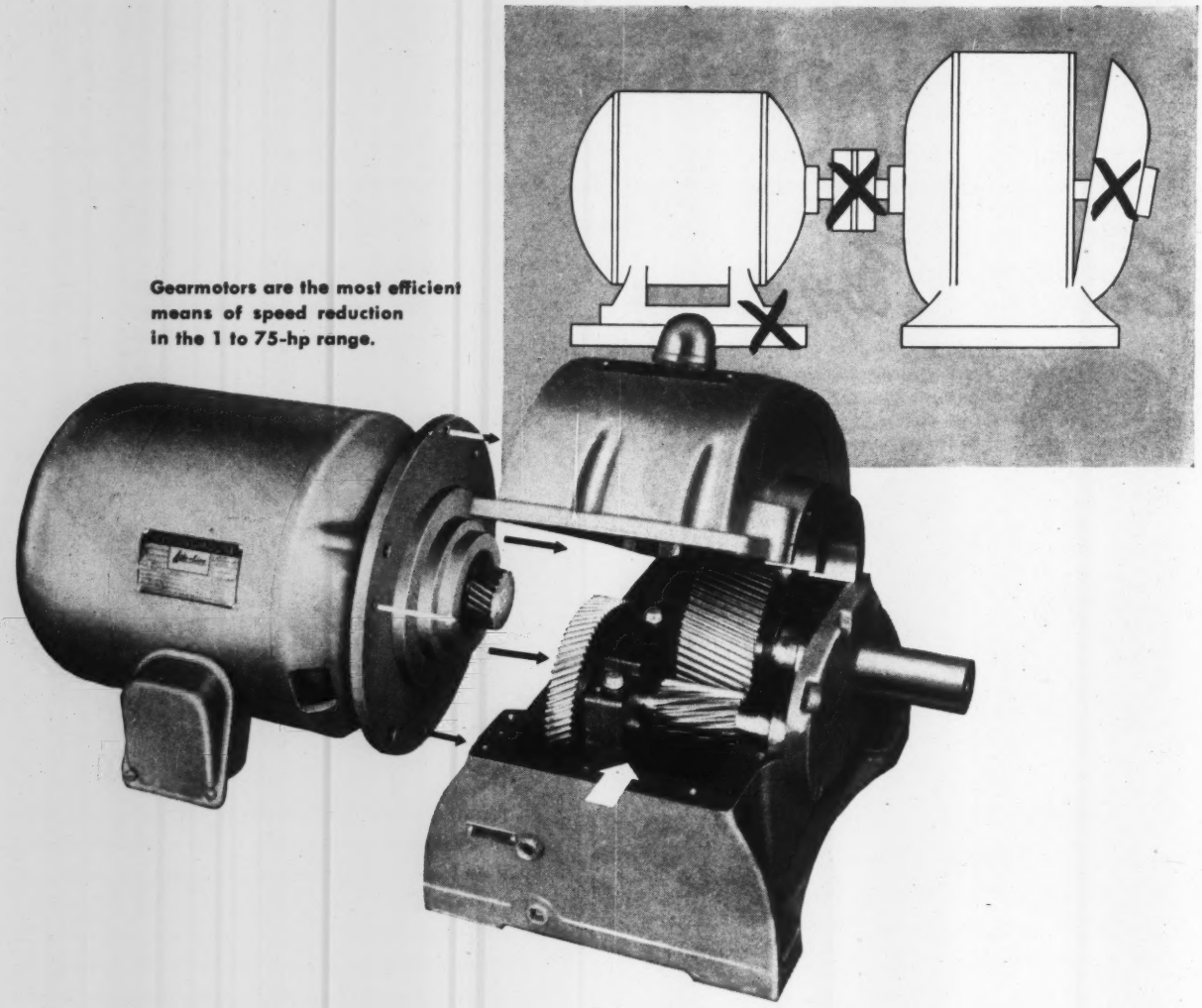
- ☐ Elastic Stop Nut Bulletin
- ☐ Rollpin Bulletin
- ☐ AN-ESNA Conversion Chart
- ☐ Here is a drawing of our product. What fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone___ State_____



Gearmotors are the most efficient means of speed reduction in the 1 to 75-hp range.

Here's why *Life-Line* GEARMOTORS stay on the job longer

LESS TIME OUT FOR SERVICING MOTOR

Removing the motor from a Life-Line gearmotor takes but a few minutes. Remove the motor mounting bolts and you are on your way—and, reassembly is just as simple and fast. Install the mounting bolts and the job's complete. No realigning of shafts—no coupling to adjust—no mounting feet to shim.

Should you be "on the spot" where down time is critical, this means that your spare motor can be quickly and easily installed. At the most, it is a simple assembly of the adapter bracket.

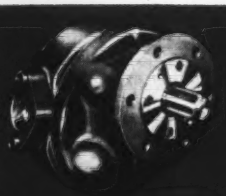
LESS TIME OUT FOR SERVICING GEARS

Here again, Life-Line's split case construction pays off. Simply by removing the top half of the gear case, the gears can be inspected or removed without touching the mounting bolts—without draining the oil—without disturbing the connected load.

Ask your Westinghouse representative for the details on how Life-Line gearmotors pay for themselves in production time saved. For descriptive literature, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-07313-A

YOU CAN BE SURE...IF IT'S Westinghouse

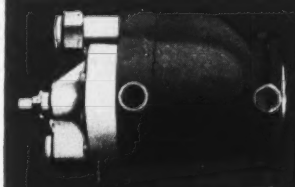
PUMPS for INDUSTRY



HYDRECO

GEAR TYPE PUMPS

Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.



STRATOPOWER

PISTON TYPE PUMPS

Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rpm with maximum of 4500 rpm . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.

FLUID POWER PUMPS

The most comprehensive range of types, capacities and pressures in Hydraulic Pumps for industrial equipment, presses, machine tools, materials handling, metal working, mining, petroleum, gas and aviation applications. Hydraulic Motors, Cylinders and Valves to develop complete Hydraulic circuits.

LIQUID HANDLING PUMPS

An exceptionally broad range of types, sizes and special constructions to handle virtually "any substance that will flow through a pipe" including: syrups, acids, sludges, slurries, asphalt, bunker fuel, etc.

VACUUM PUMPS

High Vacuum Pumps for laboratory, electronic, atomic research, biological and other chemical processing, vacuum refining of metals, de-aerating, dehydration, vacuum drying, refrigeration, etc.

Write for full information ➘

DUDCO

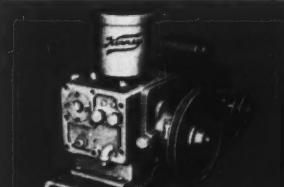
DUAL VANE TYPE PUMPS

DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in dual units operating from a single drive. Hydraulic motors with starting torque outputs to 14,000 lb. in.

KINNEY

LIQUID HANDLING PUMPS

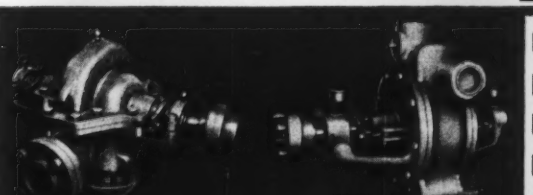
A complete range of sizes in Rotating Plunger and Herringbone Gear Pumps to handle light or heavy liquids from gasoline to molasses. Available in plain or steam jacketed models.



KINNEY

VACUUM PUMPS

Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.



AURORA

CENTRIFUGAL & TURBINE PUMPS

Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.

THE NEW YORK AIR BRAKE COMPANY
230 Park Ave., Dept. ME-1, New York 17, N. Y.

Gentlemen: Kindly send additional information on the pumps I have checked.

☐ Hydreco Pumps ☐ Kinney Liquid Handling Pumps
☐ ☐ Stratopower Pumps ☐ ☐ Kinney Vacuum Pumps
☐ ☐ ☐ Dudco Pumps ☐ ☐ ☐ Aurora Pumps

Name_____

Address_____

City_____ State_____

THE NEW YORK AIR BRAKE COMPANY

230 PARK AVENUE • NEW YORK 17, N. Y.

NO Reducing Valve Needed

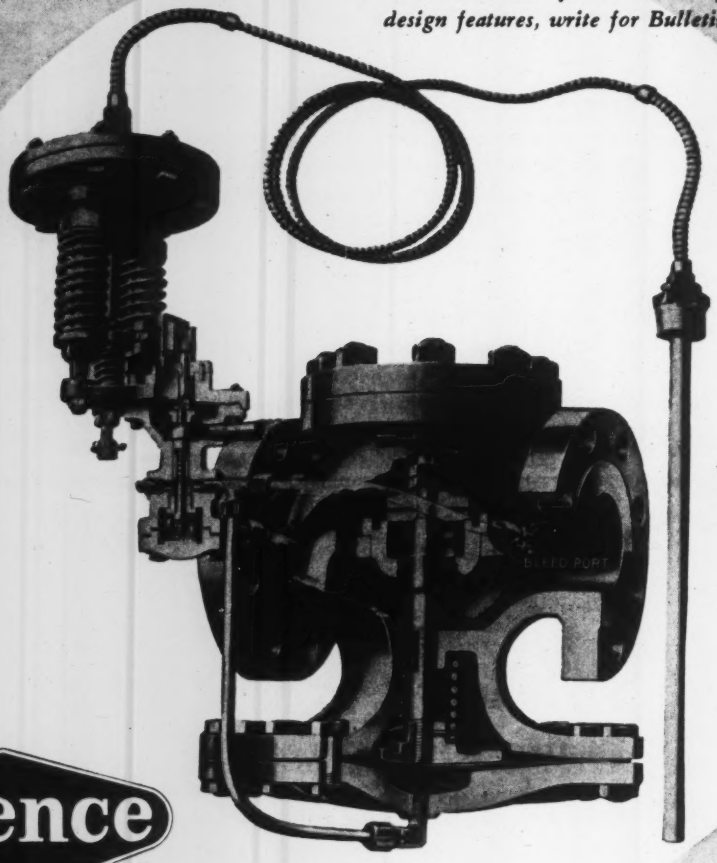
Here's real economy in temperature control.

Because Spence Temperature Regulators are designed to limit heater steam pressures to an adjustable maximum, the need for a separate reducing valve is completely eliminated.

The Spence Regulator takes steam directly from the boiler or high pressure line, reduces the pressure and regulates the flow as required to maintain a constant temperature output from the heater.

This means one relatively small combination pressure and temperature regulator replaces a reducing valve of the same size and a larger temperature regulator. Practically the entire cost of the large separate temperature regulator is saved. And, the total saving would also include the cost of a 3-valve by-pass along with all labor for installation.

This design feature is just one of the reasons for the thousands of Spence installations throughout American industry. *For details of other important design features, write for Bulletin T50.*



SPENCE
TYPE ET150
Temperature
Regulator

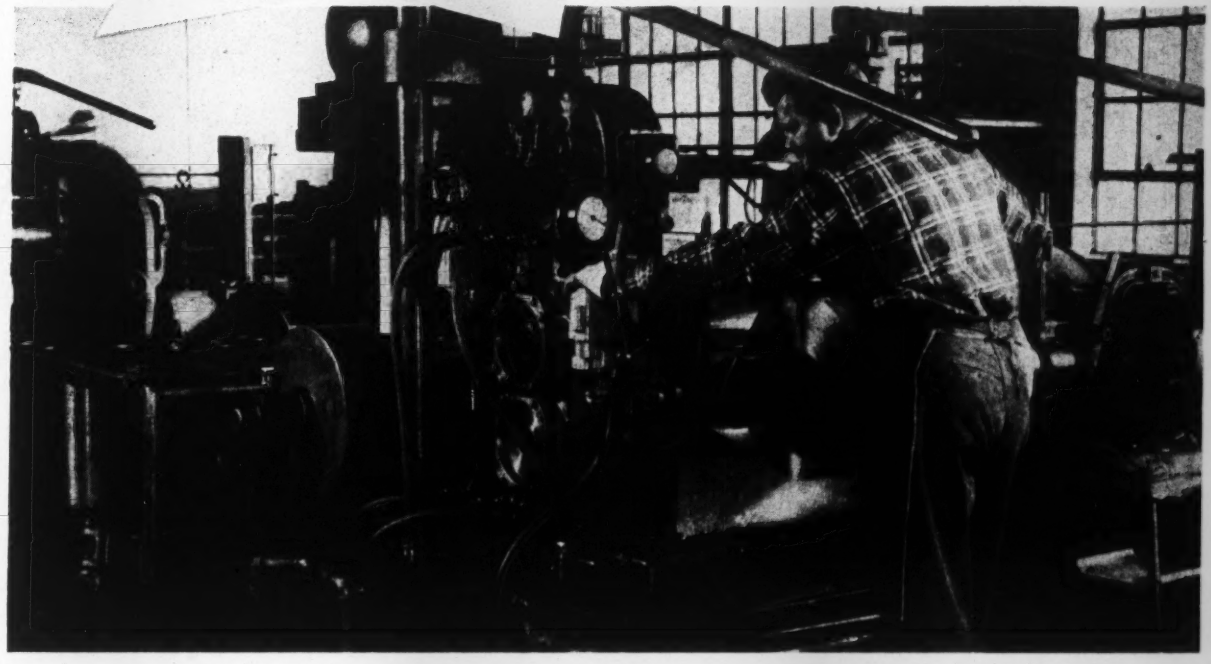
Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

SE-131

Let AIR do the work!

ON THIS ALUMINUM MILL at the Baltimore plant of Crown Cork and Seal Co., tension is regulated by controlling the input speed of aluminum foil. It is done with a pneumatic brake applied to the feed roll. Air pressure to the brake is controlled with a Westinghouse Flexair® Pressure Control Valve. Since this pneumatic system was installed scrap losses have dropped about 2%, while production has increased 15%.



Three valves, some pipe, and three brakes save 40,000 lbs. of aluminum a year

You know those little protective discs of aluminum foil under many "Crown" bottle caps? At the big Baltimore, Maryland, plant of Crown Cork and Seal Company, they roll and punch 2,000,000 lbs. of aluminum foil a year just to supply those discs.

It's precision rolling too. With a tolerance of only 1/10,000″ on the final thickness. To maintain this hair-splitting accuracy, pneumatic tension control has been installed on all three of Crown Cork and Seal Company's rolling mills. It replaces manual control.

Off-size scrap losses have been reduced at least 2%; that's 40,000 lbs. of aluminum a year. At the present price of foil, this saves *$18,000*—several times more than the cost of the pneumatic systems. In addition, production has been stepped up about 15%.

This simple pneumatic system, built around Westinghouse Air Brake controls, *automatically maintains* the correct air pressure. Operating 16 to 20 hours a day for the past year, it has proved to be completely reliable.

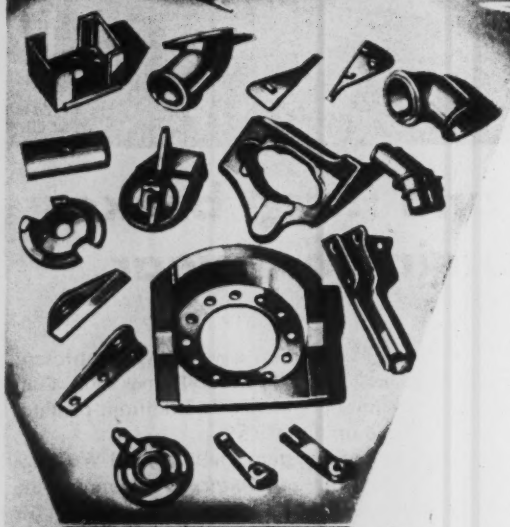
Our experienced engineers will be glad to help you design a pneumatic control system for your equipment. Just drop us a line.

Westinghouse Air Brake COMPANY

INDUSTRIAL PRODUCTS DIVISION **WILMERDING, PENNA.**

FACTORY BRANCH: EMERYVILLE, CALIF. **IN CANADA: CANADIAN WESTINGHOUSE CO., LTD., HAMILTON, ONTARIO**

The new North American FJ-2 carrier-based jet fighter



Production Teamwork puts the NAVY FURY in the Air!

AMONG the many specialists supplying component parts for the Navy's new "Fury" Jet Fighter is Parker White Metal Company. Parker Die Castings are used on the upper fuselage door access assembly, fuselage cooling duct system, fuel system, air fuel locks, air valves on intake ram, surface control system and as components of the highly classified gun-camera. Parker Die Castings are economical, strong and light weight. Machining is virtually eliminated, thus reducing costs. You will find Parker Die Castings highly practical from your point of view. Consult with Parker engineers on your next die casting requirements. Nearly a half century of experience is yours for the asking.

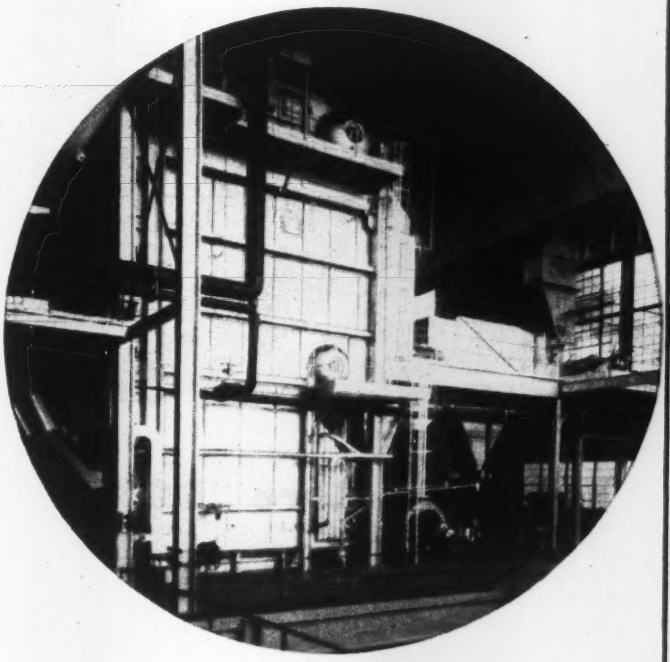
and when you think of Die Castings THINK OF

Parker White-Metal Company • 2153 McKinley Ave., Erie, Pa.

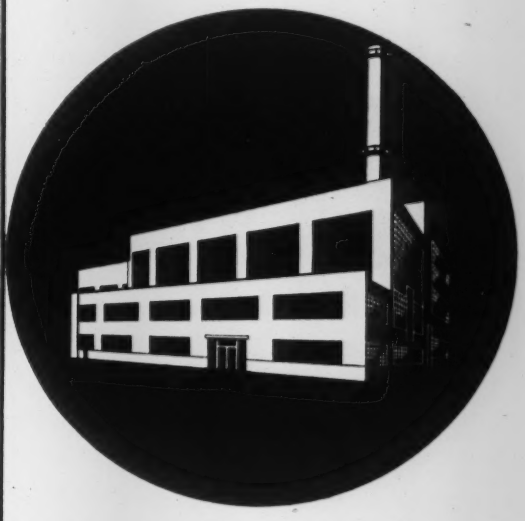
PARKER ALUMINUM and ZINC *Die Castings*

City of Manitowoc installs fifth WICKES steam generator

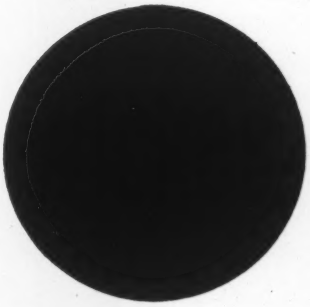
To provide a dependable source of power for the City of Manitowoc, Wisconsin, the Manitowoc Public Utilities Commission has just installed a fifth WICKES Steam Generator capable of producing 175,000 lbs. of steam per hour at 525 psi. Final steam temperature is 750°F. The new WICKES Boiler has 11,600 sq. ft. of heating surface. It is equipped with an economizer and fired by spreader stoker.



R. E. Cannard — Chief Engineer and General Manager



WICKES can fill your requirements for all types of multiple drum boilers generating up to 250,000 lbs. steam per hour at pressures up to 1000 psi. adaptable to any standard method of firing — oil, gas, single retort underfeed or spreader stoker. For pressures up to 900 psi. with sustained steam production up to 35,000 lbs. WICKES Type A Boilers can be shop assembled, ready for immediate installation. Write today for descriptive literature or consult your nearest WICKES representative.



THE WICKES BOILER CO., SAGINAW, MICHIGAN RECOGNIZED QUALITY SINCE 1854
DIVISION OF THE WICKES CORPORATION

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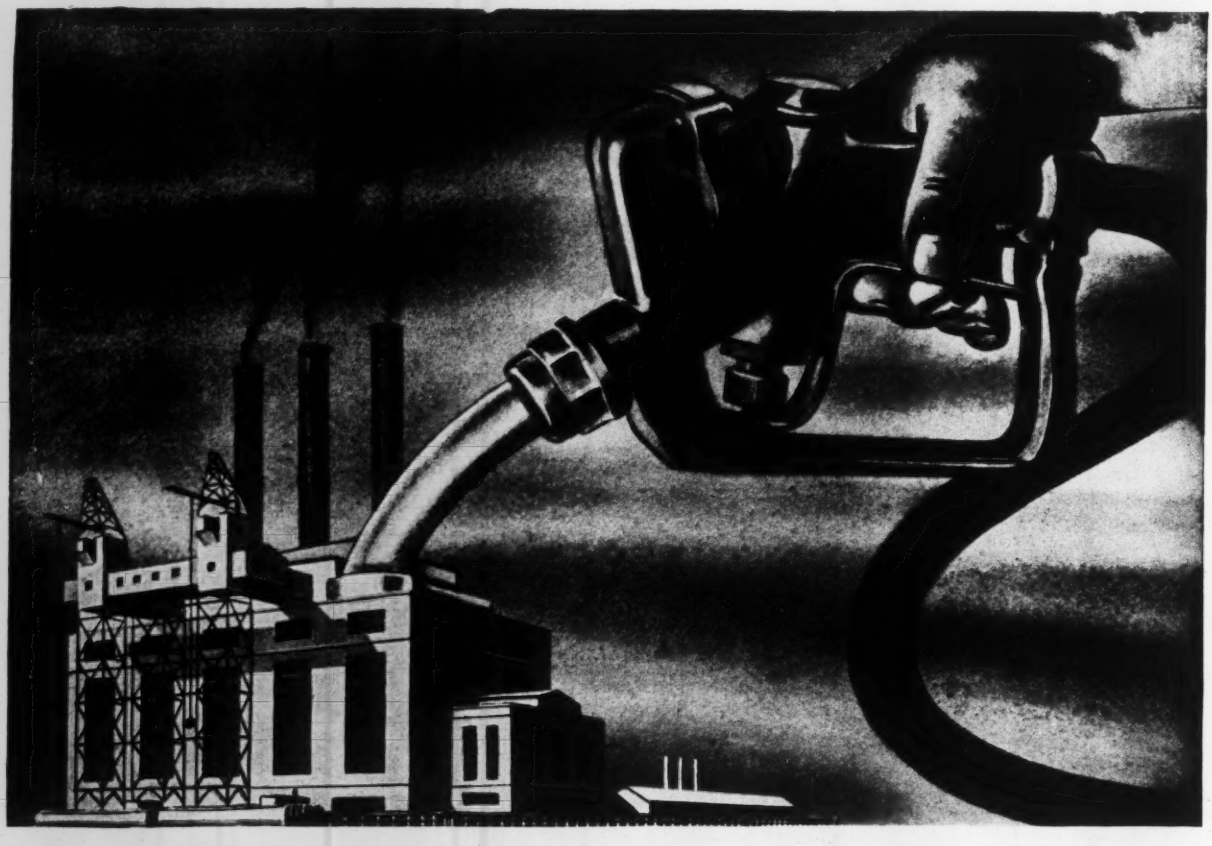
150



Refill For Plants That Need More "GO"

Are increased production loads demanding more than your plant can deliver? Here's how a power company we know tackled this problem. The approach used may help you, too.

In their case, demands called for such increases that a new station was needed. And because the area was so densely populated, tight operating economy was as much a "must" as peak productivity.

The boiler designed to meet these needs was built to deliver over a million pounds of steam an hour. In this design, steam scrubbers and cyclone separators literally cleaned the steam to protect superheaters from impurities that cause overheating and corrosion, and to help turbines keep peak efficiency. By making possible greater water level variations, in addition, this boiler permits larger, faster, *safer* load swings, while other new features assure longer life, lower operating costs, more power.

What *approach* assures equipment advances like these? Combined planning by engineering staffs of progressive Equipment Builders working with power engineers and materials suppliers. And for its knowledge of materials—as well as the design freedom, strength and rigidity of its specialty steel plate, heads and shapes—such builders turn to Lukens regularly.

Would you like them to help you? For their names, write us today, explaining your need. Manager, Marketing Service, Lukens Steel Company, 402 Lukens Building, Coatesville, Pa.

LUKENS

World's Leading Producer of

SPECIALTY STEEL PLATE · PLATE SHAPES · HEADS · CLAD STEELS

LUKENS STEEL COMPANY, COATESVILLE, PA.

NOW - BIG NEWS

IN THE POWER AND HEATING FIELD

– Just off the press and ready for YOU!

MAIL THIS COUPON *Today!*

Fully illustrated, colorful 12-page catalog contains complete data and specifications on models, sizes, capacities, operation and advantages of the new Titusville-Iron Fireman Boiler-Burner Unit. This catalog yours without cost or obligation. Send coupon to Titusville Iron Works Co. or Iron Fireman Manufacturing Co.

MAIL TO TITUSVILLE or IRON FIREMAN AT ADDRESSES BELOW.

Please send free copy of the new Titusville-Iron Fireman Boiler-Burner Unit Catalog.

Name _____

Company _____

Street Address _____

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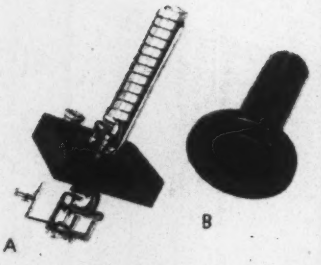
Iron Fireman Mfg. Co.
3063 West 106 Street,
Cleveland 11, Ohio

Titusville Iron Works
315 S. Franklin St., Titusville, Pa.
Division of Struthers Wells Corp.

Accurate Measurement of

HIGH DIFFERENTIAL PRESSURES



Heart of the Foxboro Type EH Differential Pressure Controller (below) is the heavy-duty stainless steel helical measuring element (A) with its alloy-steel housing (B). This assembly is mounted at rear of instrument case, the motion of the helical being transmitted to the instrument mechanism through a friction-free pressure seal bearing.

...at high statics!

Differential pressure measurements at ranges far above the limits of conventional devices, and at statics up to 2200 psig, can be readily recorded and controlled by the new Foxboro Type EH Instrument.

Major chemical companies have employed this instrument to measure pressure loss across fixed catalyst beds. By operating until a pre-determined pressure loss indicates catalyst exhaustion, instead of shutting down and regenerating on a time cycle, they have increased production, cut costs.

Many large steam generating plants have installed Type EH Instruments to control differential pressure across boiler feed valves, thus assuring at all times that the boiler feed pump is operating at pressures high enough above boiler pressure to assure safe operation.

Differential pressure ranges are available from 0-100 psig minimum to 0-2200 psig maximum. Design of the helical actuating element assures precision over the entire measuring span. Heavy-duty construction of the element and its housing makes operation safe.

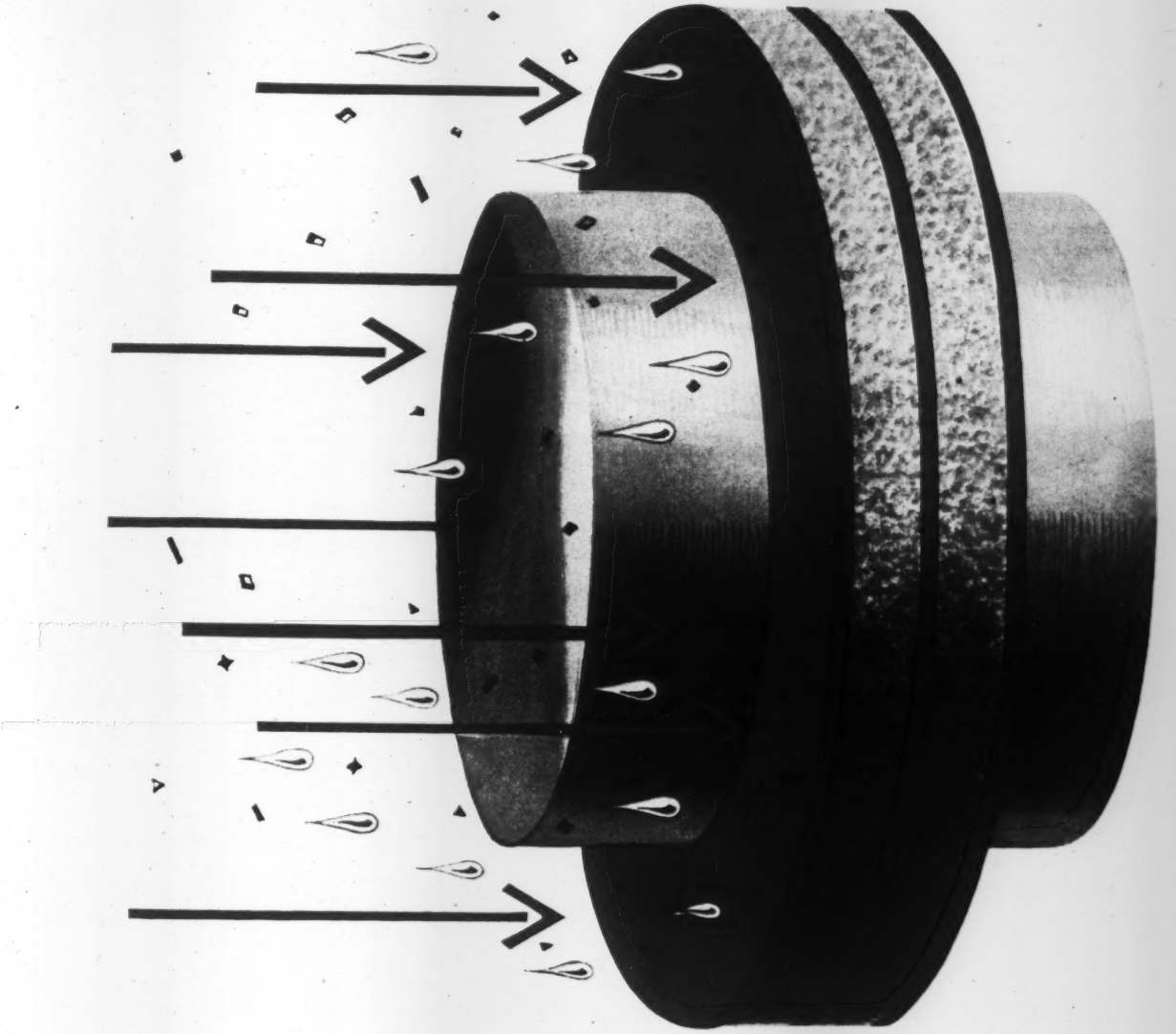
Write for details on Foxboro Type EH Instruments for indicating, recording, controlling, transmitting.

THE FOXBORO COMPANY, 968 NEPONSET AVE., FOXBORO, MASS., U.S.A.

FOXBORO
REG U S PAT OFF

PRESSURE INSTRUMENTS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



"WORK CLOTHES" SOLVE TOUGH SEALING PROBLEMS

American Felt Company
TRADE MARK

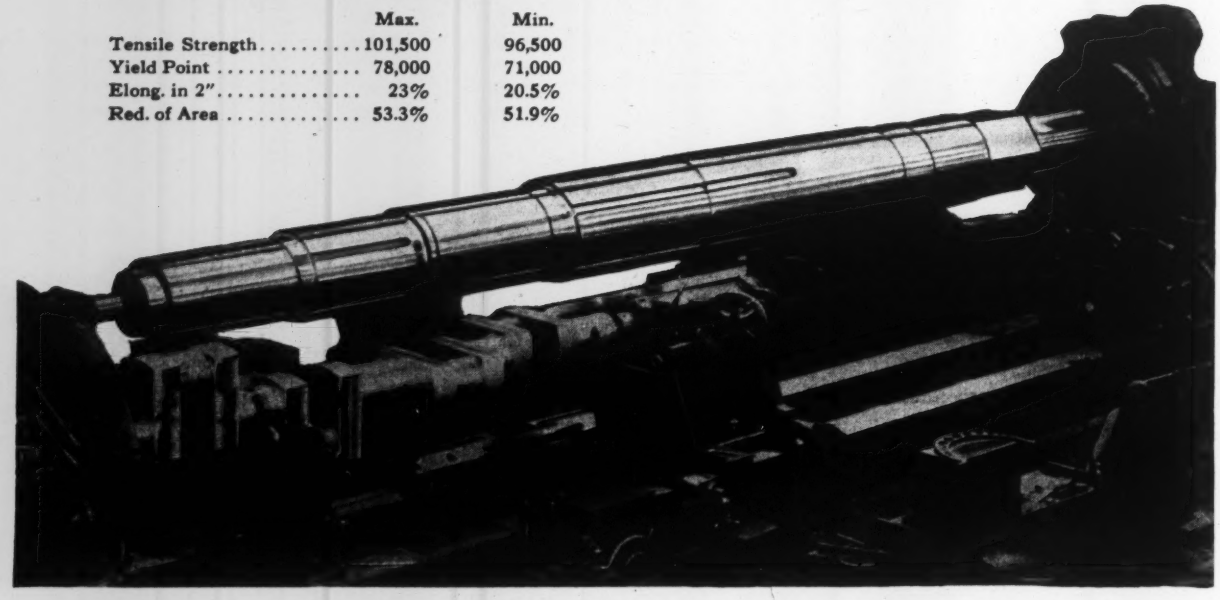
GENERAL OFFICES: 50 GLENVILLE ROAD, GLENVILLE, CONN.

SALES OFFICES: New York Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, San Diego, Montreal — PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I. — ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

Seal off your sealing worries with felt "work clothes!" Above is an OilFoil seal, used as protective "work clothes" in many machines. It consists of two layers of felt, bonded with three septums of Hycar, the synthetic rubber-like substance that is impervious to and unaffected by oils, greases and the hydrocarbons used in hydraulic systems. Such washers can have one, two, or three septums, to keep fluids in and seal out water, dust, dirt, gases, and retain pressures. If there is no enclosed lubricant, the felt can be impregnated with oil or grease, to provide long-time lubrication. OilFoil seals are supplied cut to exact dimensions, ready for assembly. For more information, write for Data Sheet No. 11, "Felt Seals, Their Design and Application."

NICKEL STEEL FORGING . . . a 58,950 lb. hoist drum shaft, 24" in diameter at its widest portion and 42' 9" long, produced by ERIE FORGE & STEEL CORP. Inspection revealed very fine grain. After being normalized and drawn, actual tensile tests in the longitudinal direction showed the following:

	Max.	Min.
Tensile Strength	101,500	96,500
Yield Point	78,000	71,000
Elong. in 2"	23%	20.5%
Red. of Area	53.3%	51.9%



How Erie Forge Obtains Superior Properties in Large Forgings

To develop high tensile and elastic properties in large forgings, such as this giant shaft, by heat treatment is much more difficult than with smaller forgings.

For even though dimensions of a large piece may allow liquid quenching, section sizes involved ordinarily limit the cooling rates.

Experience shows that superior mechanical properties in large forgings depend largely on suitable alloy content . . .

Fundamentally, that is why the output of ERIE FORGE & STEEL CORPORATION of Erie, Pennsylvania, includes scores of large forgings produced from nickel alloyed steel.

Nickel, either alone or in combination with other alloying elements, exerts highly beneficial influences. Its strengthening effect on ferrite is independent of carbon content or heat treatment of the steel, while its effectiveness in reducing the rate and temperature of the upper transformation, induces better response to the necessarily milder heat treatments used.

Nickel alloy steels may help you obtain peak performance from vital parts of *your* products or equipment. Send us the details of your problems for our suggestions. Write us now.

At the present time, nickel is available for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

EMBLEM OF INCO SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 75 NUMBER 9

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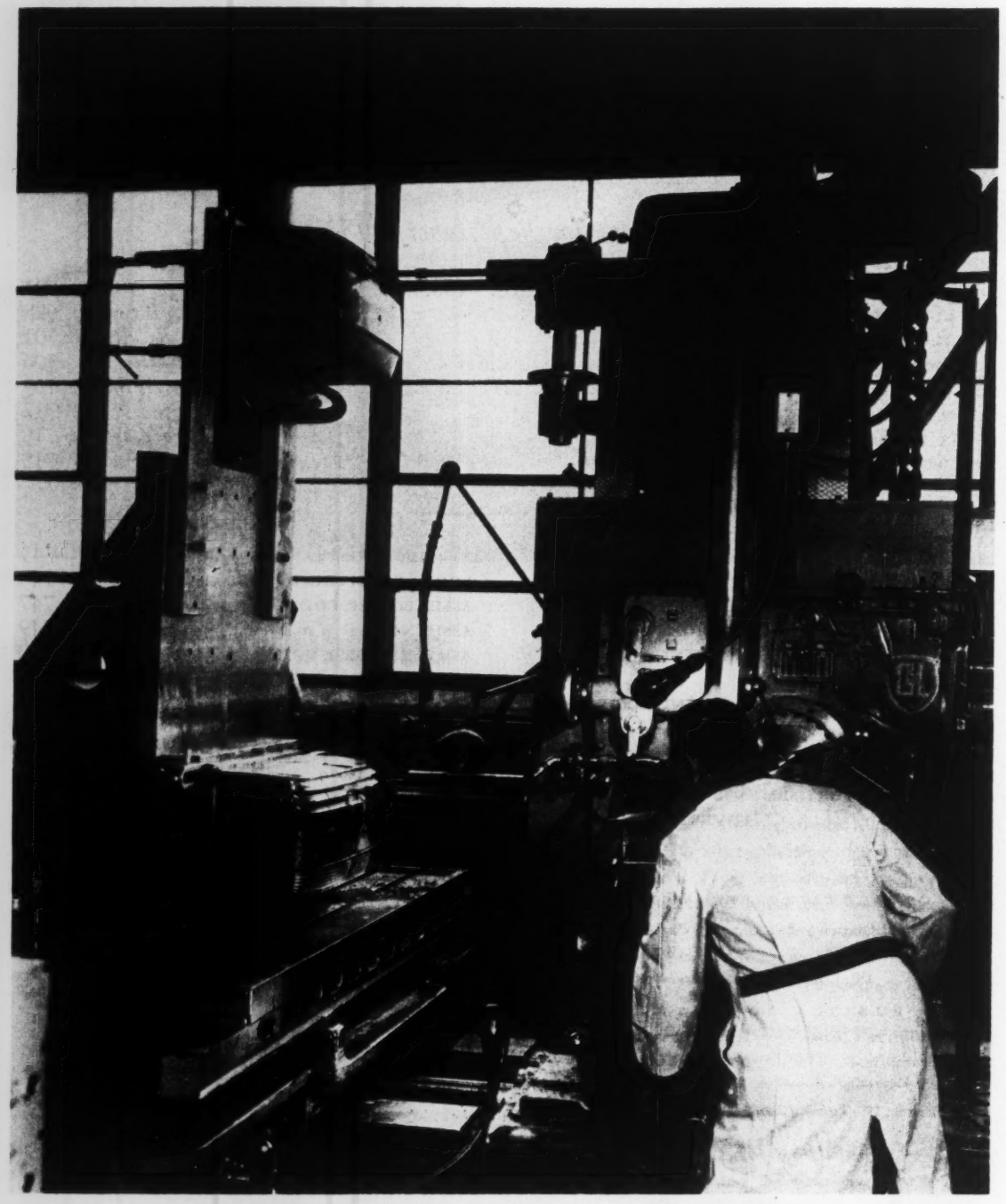

Making Steel Dies for Large Thermosetting Plastics Moldings

(*Here, a block of tool steel, bottom, is being formed to make the die for a Philco unit air conditioner. The pattern for the die is shown at the top. Photo courtesy General American Transportation Company.*)

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1953

GEORGE A. STETSON, *Editor*

ASME Publications

THE American Society of Mechanical Engineers conducts what is probably the most varied and extensive program of publications carried on by any professional engineering society in this country.

Probably no one, unless he were to refer to official statistics, could make a complete list of every ASME publication issued during a given year or currently available and in constant use. Because of the variety of these publications and the fact that most engineers are engaged in their own special fields rather than the entire area of practice and technical knowledge represented by the Society's interests, few ASME members appreciate the full value and significance to the profession and hence to the nation of this phase of ASME activity. Without a great body of representative and loyal members, this service could not be maintained. Because of this membership the Society commands public confidence and its actions and publications have authority and prestige. Correspondingly, the influence and effectiveness of the services of individual members on behalf of their profession are enhanced because of the Society. This two-way interchange of giving and receiving affords opportunities, benefits, and services, which, in the aggregate, amount to vastly more than the sum of their individual parts.

It is common knowledge that publication programs such as that in which the ASME is engaged are costly. Yet the expense of the ASME publications' program is met without using members' dues.

What is the reason for this extraordinary circumstance? One obvious reason is the fact that ASME publications pay for themselves through advertising income, sales, and subscriptions. This reason stands out prominently because the cold figures of income and expense are to be found in the Society's financial reports.

But gratifying as the financial reports may be, they fail to reflect contributions in time, money, and services for which no accounting can be made. These contributions are made by individual members and nonmembers and by the companies and organizations which employ them. Without these contributions the Society would have nothing to publish except news and reports of its activities, and the activities themselves, under such circumstances, would be too insignificant to command support. There would be no Society.

Consider technical papers, for example. The authors of these papers receive no honoraria for their work. The expense of preparation and of attending a meeting to present the paper is borne by the author or his employer. Thousands of dollars of direct and indirect expense in time and dollars go into practically every paper published by ASME. Many of these papers could be sold by their authors to technical magazines. Yet the authors prefer to give their papers to ASME and incur additional expense to present them at an ASME meeting. The Society meets only the expense of providing a forum for presentation, for publishing the paper, and for an organization to make these possible.

As an example of what may be involved in providing technical papers for ASME meetings and publications, it is reported that a loyal ASME member has spent the major portion of his time for six months in planning a few sessions and that expense to his employer has amounted to several thousand dollars. In addition to this there is involved the time and expense contributed by each author who has prepared a paper for these sessions, a sum which cannot be estimated readily. Such contributions to the engineering profession would not be forthcoming were it not for the fact that thousands of individual engineers from coast to coast support a Society that provides the forum and the publications through which the knowledge of experts is made public for the benefit of their fellow engineers.

But technical papers represent only one segment of the ASME publication program. Hundreds of engineers, members and nonmembers alike, serve on ASME technical committees which produce and maintain dozens of standards and codes and organize and report research projects of great value. Here again the contribution of the Society in dollars to service these projects and publish the results is insignificant compared to the total expenditures made by the committee men and their employers. Here again are Society activities of the highest value and importance that are not financed directly by members' dues but by monies from other sources and the general income from advertising, subscriptions, and sales of the publications through which the results of the individual projects are made public. Here again the achievements are possible because there exists an engineering society made up of nearly 40,000 members.

What are the publications which are made available by ASME?

The oldest ASME publication is the Transactions, of which the *Journal of Applied Mechanics* is a part. In the Transactions are papers contributed by ASME Professional Divisions and Technical Committees. These papers have been presented at Society meetings and divisional conferences, recommended by the sponsoring agencies for printing in full, and selected by the Publications Committee as being of "permanent" value. Four

of the twelve monthly issues of Transactions, March, June, September, and December, contain the papers of the ASME Applied Mechanics Division and certain other features, such as sections known as "Design Data," "Brief Notes," book reviews, and discussions of papers previously printed. These four issues constitute the quarterly known as the *Journal of Applied Mechanics*.

By vote of the members, Transactions, including *Journal of Applied Mechanics*, was placed on a subscription basis in 1948. Subscription rates are nominal and do not cover the costs. For $4, the member may receive eight Transactions numbers per year; for $2.50, the four *Journal of Applied Mechanics* numbers; and for $6, the entire twelve numbers. Separate annual indexes are issued for each of these sections for the benefit of those who wish to bind their copies. All twelve numbers are available in cloth bound form, with certain supplemental material and complete indexes, at a price of $7.50 to members. Items on the members' dues bill afford an easy means of subscribing to Transactions.

Every ASME Student Branch receives gratis all twelve numbers of Transactions and a copy of the annual bound volume. Depositories of bound volumes of ASME Transactions are maintained free of charge in important public and institutional libraries all over the world, and the list of Transactions subscribers contains the names of dozens of company, special, and public libraries. Hence for reference purposes ASME Transactions are available in practically every important engineering center. The annual bound volume of ASME Transactions contains more than 2000 pages.

The principal means by which the Society keeps in touch with its individual members is the monthly magazine, MECHANICAL ENGINEERING. Every member receives MECHANICAL ENGINEERING as part of his dues, although income from advertising, sales, and subscriptions of all ASME publications is sufficient to cover all publication expense without drawing on dues income. MECHANICAL ENGINEERING is a technical and news magazine, containing most of the features customarily found in such publications: Special articles, editorials, book reviews and book notes, a department of general engineering interest called "Briefing the Record," another, "ASME Technical Digest," which contains digests of ASME papers available in Transactions, *Journal of Applied Mechanics*, or as ASME preprints, the actions of the ASME Boiler Code Committee, correspondence and comment, and the "ASME News," devoted to Society meeting programs and affairs, other notices of general engineering interest, and advertising.

Because ASME members' interests are widely diversified, the text pages of MECHANICAL ENGINEERING are fairly general in character. An attempt is made to use ASME papers that have wide and novel appeal with the object of bringing to the attention of readers, developments in fields in which they may not be directly engaged. The source of most of the special articles is the vast store of papers presented at Society meetings and divisional conferences. Cross fertilization of ideas from one field to another is a prime objective in making the choice of the papers printed.

Two other ASME publications are available to ASME members without cost but on request: The ASME Membership List, issued approximately every two years, and the ASME Mechanical Catalog and Directory, a valuable classified list of all producers of mechanical equipment supplemented by a section of "condensed catalogs" of manufacturers and a complete catalog of all ASME publications.

ASME meetings and division conferences make available about twice as many technical papers as the Society can afford to print in full in its periodical publications. As a supplemental means of publishing this vast volume of material other means are used. For every scheduled paper received in time for processing a preprint is issued. Most of these are in mimeographed or similar form. A few are preprinted from MECHANICAL ENGINEERING, Transactions, and the *Journal of Applied Mechanics*. Members may purchase these at the meetings or by mail. Digests of all of these preprints, with order form, appear in MECHANICAL ENGINEERING. Every preprint is indexed by the Engineering Index Service, Inc., and is available in the Engineering Societies Library. As soon as a year's output of ASME preprints, not printed in full in the Society's periodical publications, is complete, the Library binds the entire set. Included in this set are the manuscripts of ASME papers not available in any other form. Photostatic copies of any of these preprints and manuscripts may be purchased, and a complete list of the contents of these library volumes will in the future be published with the other ASME indexes.

For the convenience of members who wish to order copies of ASME preprints, books of coupons may be purchased; and with the 1953-1954 bill for dues each member will receive 10 special coupons free of charge.

Another ASME periodical publication to which members may subscribe at reduced rates is the *Applied Mechanics Reviews*, which contains a brief summary article every month and signed critical reviews of articles and books published the world over. This highly valuable publication is financed by subscriptions and subsidies from government and private sources entirely outside the Society's regular budget.

Several ASME Professional Divisions hold annual conferences at which the payment of a modest registration fee entitles the registrant to preprints of the papers and of the proceedings, if such a volume is issued. These preprints are treated like all other ASME preprints and the proceedings may be purchased by members who did not attend the conferences.

Every year sees substantial additions to the long list of special ASME publications—codes, standards, reports, bibliographies, biographies, and other books and pamphlets. Notices of these publications appear in MECHANICAL ENGINEERING and in the catalog of ASME publications. Members may purchase them at substantial discounts. Copies of the most important of these publications are on display at every national meeting. They make an impressive display and should be a source of pride to every member who sees them, when he realizes that his support of his Society makes this service to the engineering profession possible.

Light-Alloy FORGING—DESIGN *and* PRODUCTION PROBLEMS

As Related to Heavy-Press Operations

By A. E. FAVRE

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INTRODUCTION

AT A meeting of engineering and production representatives from leading aircraft builders about a year ago at the Aluminum Company of America's Cleveland Works, the author presented an outline of the progress up to that time on light-alloy forging practice. The occasion was the inspection of the 15,000-metric-ton forging press which was just going into production at that time. Only a few parts had been produced on the press, and the discussion necessarily was confined to general principles governing good forging and die design and to the extensive experience that had been accumulated in the manufacture of forgings on smaller hydraulic presses up to 3000 tons capacity.

The present paper represents a progress report rather than an authoritative document on the design and production of large-press forgings. During the past year we have constructed dies and have produced some thirty or more different parts on the 15,000-metric-ton hydraulic press, processing more than 5,000,000 lb of metal through it. It is the result of that experience and its implications for the future which will be discussed. Additional progress reports should be made in the future as press operators gain knowledge and experience from the use of their equipment.

The product from these presses, of course, will be used mainly by the aircraft industry—that will be true at least for a long time to come. Aircraft manufacturing is a dynamic industry. The obsolescence rate is exceedingly high, and radically new ideas in design and construction are the order of the day. The main problem of the press operator in serving such an industry will be to keep pace with it, i.e., to maintain a sufficient degree of flexibility in his operations so that current progress can be translated into practical and economic engineering contributions before service requirements and design changes kill the job in its early stages. Such a task is never an easy one when the tools of production are heavy and expensive in time and money. This challenge can be met successfully only by the closest and most co-operative relations between the aircraft builders and the suppliers of these large light-alloy press forgings. That necessity has been emphasized many times before this, but needs to be reiterated often.

GENERAL FORGING CONSIDERATIONS

Most of Alcoa's experience until recently in the production of light-alloy airframe forgings has been on hammers, from very small units of 2000 or 3000 lb up to hammers of 35,000 and 40,000 lb capacity. In addition, many small and medium-sized forgings have been produced on mechanical forging presses up to 2500 tons capacity, and on hydraulic presses of 1500 to 3000 tons.

All the recommended design proportions and related engineering standards as set forth in the company's design manual have been established primarily on the basis of hammer fabrication. Since March, 1952, when the 15,000-ton hydraulic press went into production, some 30 or 40 sets of new press dies have been constructed and quite a number of large hammer dies have been adapted for press production. In all, more than 5,000,000 lb of metal have been processed, in the course of which a considerable amount of valuable data and experience have been accumulated. It is largely on the basis of this accumulation of data and experience that this paper has been prepared.

While we are by no means able at this time to present design factors and standards which can be applied generally to press-forging practice, nevertheless there are certain clear indications which can be brought out and which should be of definite assistance to those responsible for the engineering design of large light-alloy press forgings. In general, results obtained have been quite encouraging from the standpoints of surface quality, dimensional uniformity, reduction of required draft angles, ability to produce thinner webs and ribs, and increased die life. No improvement over hammer forgings has been noted in mechanical properties or metallurgical quality and none was expected.

Surface quality has been improved greatly as evidenced by greater smoothness and freedom from laps, folds, and other defects which have to be chipped out between hammer operations or ground out and polished in final inspection. The reason for this is that the forging is blocked or finished in a single stroke of the press so that the small abrasions and slivers, developed as a result of repeated hammer blows, which never hit twice in exactly the same place, are avoided.

Dimensional uniformity from forging to forging has been better than expected. Dies are designed so that they come together and, although they sometimes do not do so in hydraulic-press operations, a high degree of uniformity in total pressure and unit pressure does exist from forging to forging so that if temperatures, dwell, and lubrication are controlled accurately, the resultant dimensional uniformity should be good. The problem of controlling all of these factors, however, is not always easy and requires constant effort and refinement.

Draft angles which are standard at 7 deg and are rarely less than 5 deg in hammer-forging practice can be reduced easily to 5 deg, 3 deg, or even less, in press-forging. There are numerous reasons for this, the most important being the ability to incorporate knockouts in the dies, which is not practical in hammer dies.

Thinner webs and ribs seem definitely to be in the cards for forgings manufactured on presses, although perhaps not so thin as the aircraft designer could use and would like. Reduced draft angles are partially responsible for such improvement.

Contributed by the Aviation and Machine Design Divisions and presented at the Semi-Annual Meeting, Los Angeles, Calif., June 28–July 2, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

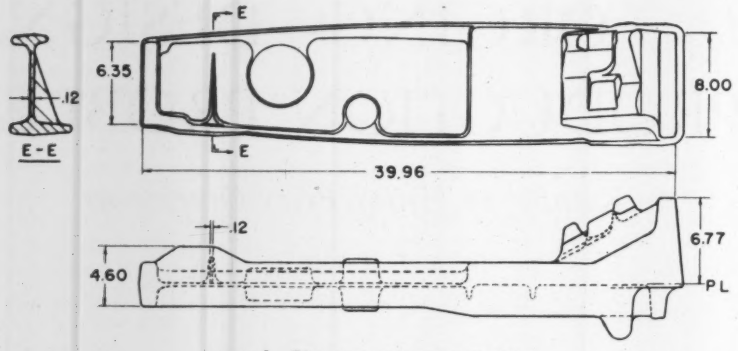


FIG. 1 75S, BOXED-IN TYPE FORGING

Superior lubrication, higher die temperatures (not practical with hammer dies), and "dwell," under pressure are other important factors contributing to this result.

DEFLECTION STUDIES ARE NECESSARY

The results of our experience with die life during the past year on the 15,000-ton press have been gratifying. On the other hand, we are afraid this may not be quite representative of what can be expected in the future. There have been no major die failures, although a large hard plateholder was broken as a result of an operating error. Since few jobs have been produced in any substantial volume, our die mortality record cannot be taken as an index of future experience. We have been careful and meticulous about our setups, which fact has been reflected in the costs—as some of our customers are prone to remind us. If the setup looks difficult or hazardous, deflection measurements are taken under pressure in order to stay within safe limits. We believe that such deflection studies will be of major importance in the successful operation of the 35,000 and 50,000-ton presses, as the concentration of die stresses on such machines easily can reach such magnitudes that no material can avoid failure.

Usually it will not be possible to provide "spare" or "reserve" die equipment for these large complex forgings. The cost in time and money will be too great, and spare equipment is not an answer to the problem anyway. If the original can be broken, so also can the spares, and in the end it will be necessary to eliminate the cause, which can only be done through a knowledge of what is happening.

Inasmuch as thin web sections with thin ribs are so insistently desired and sought by aircraft designers, it is in order at this point to examine some of the major factors which control the producibility of such design proportions. Such matters are joint responsibilities of the designer and the forging manufacturer, so that a co-operative approach between these two is most essential to any constructive result.

The conditions which must be achieved to produce forgings of relatively large area having thin web sections and narrow ribs to fairly precise dimensions may be summed up "reduction and control of required unit forging pressures." Far too much emphasis frequently has been placed upon press "size" or "capacity" in the belief that extremely high pressures will produce a complex forging in any size. No amount of pressure will cause metal to flow if the conditions are not right, and no press, however powerful, will produce a thin web panel if the forging and the dies are designed improperly. The whole secret of such production lies (*a*) in proper forging design, (*b*) in proper die design, and (*c*) in proper production practices. The objective to be sought after and achieved in all three of these is the reduction of necessary unit pressures to the absolute minimum required.

If a press has a capacity of 50,000 tons and a forging requires 40 tons per sq in. to make, the machine can produce a piece only about 35 in. square. However, if by skillful design and fabricating practices this required pressure can be reduced to 15 tons per sq in., the press can fabricate a panel about 30 × 100 in. In other words, a 50,000-ton press becomes equivalent to approximately 150,000 tons; or looked at another way, it may be reduced in effectiveness to approximately 15,000 tons.

REDUCING UNIT PRESSURES

Now what are some of the things which the forging designer can do to assist in reducing the unit pressure necessary to produce his forging? Thin webs particularly in "boxed-in" sections, Fig. 1, tend to "freeze" between the die surfaces and create enormous resistance to flow, consequently building up excessive die stresses. If relief can be given by providing "punchouts," some place is provided for the excess metal to flow, which not only makes a thinner web possible, but greatly reduces the required pressure. Sometimes the designer cannot allow a punchout, but perhaps can arrange the rib disposition so as to avoid completely boxed-in sections and trapped metal. The point is that something can be done if the problem and the necessities are understood. A designer, bent upon maximum weight reduction, often will specify and insist upon very small fillet radii between web sections and adjoining ribs. Frequently he defeats his own purpose in so doing, because the resistance of metal flow into the ribs is so increased that greater web thickness is required, or at least, in production the web section always will tend to run over the drawing limits. These are only typical examples of what is meant by forging-design responsibility.

The forging-die designer faces still another set of responsibilities—but all with the same general objective, i.e., to reduce required unit pressures. He must determine the number of blocking dies and design the impressions in each, always with the idea in mind of providing the minimum resistance to flow and the optimum distribution of metal for the next operation. He must determine the type of original stock or preformed shape, whether to use sawing, bending, or perhaps hand-forging as a preliminary operation. Gutter and flash design and flash removal are of extreme importance. Character of die surface has a great effect in reducing or increasing resistance to metal flow. Properly polished dies are very helpful—even plating may be warranted where practical.

In the actual production phase of the process, additional groups of controls and practices must be observed—but all again with the over-all objective of promoting a smooth flow of metal and holding unit-pressure requirements to a minimum. Temperature of stock, temperature of dies, and lubrication of dies are major factors here. The hotter the dies, the lower will

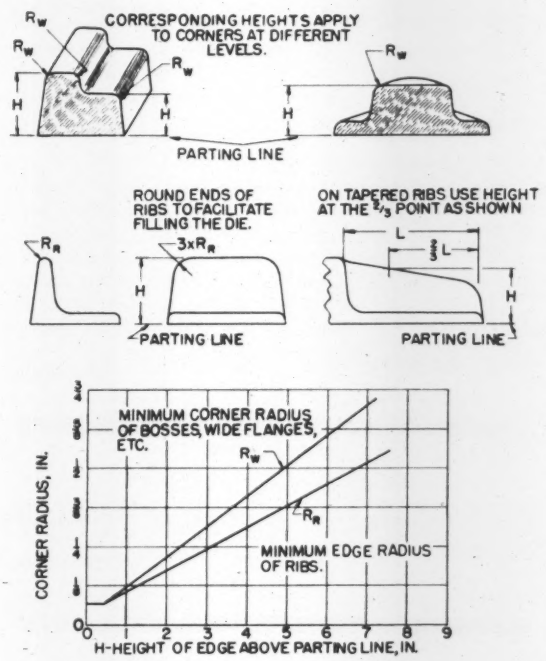

CORRESPONDING HEIGHTS APPLY TO CORNERS AT DIFFERENT LEVELS.
PARTING LINE
ROUND ENDS OF RIBS TO FACILITATE FILLING THE DIE.
ON TAPERED RIBS USE HEIGHT AT THE 2/3 POINT AS SHOWN
PARTING LINE
PARTING LINE
MINIMUM CORNER RADIUS OF BOSSES, WIDE FLANGES, ETC.
MINIMUM EDGE RADIUS OF RIBS.
CORNER RADIUS, IN.
H-HEIGHT OF EDGE ABOVE PARTING LINE, IN.

FIG. 2 RECOMMENDED MINIMUM RADII AT CORNERS AND EDGES FOR ASSURING GOOD METAL FLOW AND TO OBTAIN SATISFACTORY DIE LIFE

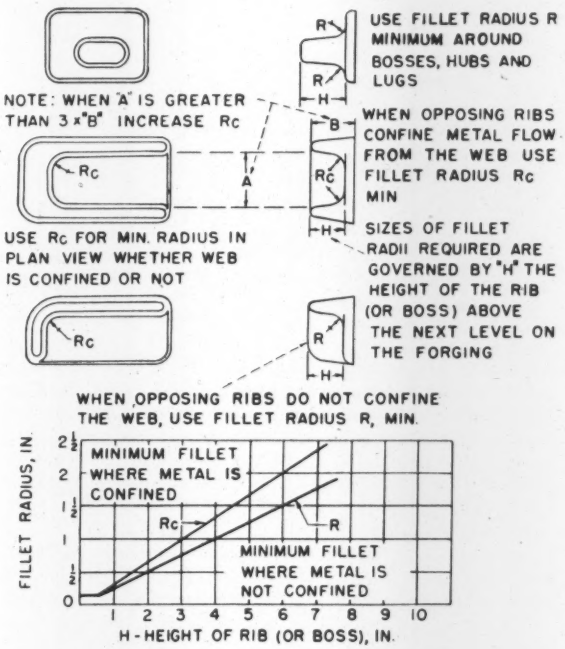
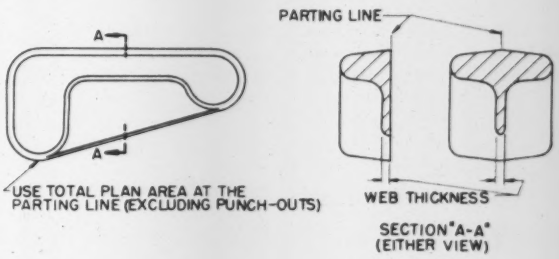

USE FILLET RADIUS R MINIMUM AROUND BOSSES, HUBS AND LUGS
NOTE: WHEN "A" IS GREATER THAN 3 x "B" INCREASE Rc
WHEN OPPOSING RIBS CONFINE METAL FLOW FROM THE WEB USE FILLET RADIUS Rc MIN
USE Rc FOR MIN. RADIUS IN PLAN VIEW WHETHER WEB IS CONFINED OR NOT
SIZES OF FILLET RADII REQUIRED ARE GOVERNED BY "H" THE HEIGHT OF THE RIB (OR BOSS) ABOVE THE NEXT LEVEL ON THE FORGING
WHEN OPPOSING RIBS DO NOT CONFINE THE WEB, USE FILLET RADIUS R, MIN.
MINIMUM FILLET WHERE METAL IS CONFINED
MINIMUM FILLET WHERE METAL IS NOT CONFINED
FILLET RADIUS, IN.
H-HEIGHT OF RIB (OR BOSS), IN.

FIG. 3 RECOMMENDED MINIMUM FILLET RADII ON RIBS AND BOSSES IN CONFINED AND UNCONFINED METAL OF DIE-FORGED ALUMINUM PARTS

be the flow resistance, generally speaking. However, the hotter the dies, the greater is the problem of die lubrication and also the problem of maintaining certain dimensional tolerances, so in the end it all comes down to a proper balance of many factors which can be determined only by trial and experience. As stated previously, at this stage we cannot set down definite standards giving practical design proportions and production tolerances. However, it is possible to outline, at least tentatively, our present ideas.

It must be thoroughly understood—as it surely is—that very thin sections such as those contemplated for integrally stiffened wing panels are not considered, in the foreseeable future, as being practicable, or even possible, as forged. Such sections, i.e., 0.060 in. to 0.120 in. can be achieved only by subsequent machining. When we speak here of "thin web sections as forged," we mean sections from about 0.140 in. to 0.225 in. We have produced nothing as low as 0.140 in. as yet, although we have produced some webs at 0.180 in. in rather heavily



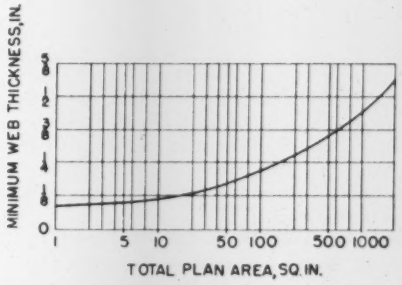


FIG. 4 MINIMUM WEB THICKNESS OF ALUMINUM DIE FORGINGS BASED ON PARTING-LINE AREAS
(Punchout holes not included in plan areas.)

restricted sections without punchouts, up to about 100 sq in. in area, the total area of the forging being perhaps 300 to 450 sq in.

DESIGN PROPORTIONS

Figs. 2, 3, and 4 indicate proportions that are used currently for hammer fabrication of large airframe forgings. It is believed that for general purposes, in so far as hydraulic-press fabrication is concerned, these proportions could be reduced by approximately 25 per cent. However, it should be emphasized that each design, for the time being, should be given individual consideration until such time that sufficient experience is obtained to permit publication of definite design data and limitations.

TOLERANCES

Tables 1, 2, 3, and Fig. 5 indicate tolerances that have been established in the past for airframes produced on hammers. There are common factors affecting tolerances for hammer and

TABLE 1 STANDARD DIE-CLOSURE TOLERANCES

MAGNESIUM NET WEIGHT OF FORGING, IN LBS.		ALUMINUM NET WEIGHT OF FORGING, IN LBS.		DIE CLOSURE TOLERANCE, IN INCHES	
FROM	TO	FROM	TO		
0	¼	0	¼	+0.032	−0.010
¼	1	¼	1	+0.032	−0.015
1	3	1	4	+0.045	−0.032
3	11	4	17	+0.062	−0.032
11	16	17	24	+0.078	−0.032
16	33	24	50	+0.093	−0.032
33	67	50	100	+0.125	−0.045
67	170	100	250	+0.187	−0.062
170	—	250	—	+0.250	−0.062

TABLE 2 STANDARD LENGTH OR WIDTH TOLERANCES

DIMENSION, IN	A EXTERIOR DIMENSIONS	B INTERIOR DIMENSIONS	C STEP AND CENTER DIMENSIONS
UP TO 8	+0.032 −0.016	+0.016 −0.032	±0.016
OVER 8 ADD PER INCH	+0.004 −0.002	+0.002 −0.004	±0.002

TABLE 3 STANDARD MISMATCH TOLERANCES

LONG, NARROW FORGINGS MAY REQUIRE LARGER MISMATCH TOLERANCES AS DETERMINED BY THE FORGING VENDOR

MAGNESIUM NET WEIGHT OF FORGING, LB		ALUMINUM NET WEIGHT OF FORGING, LB.		TOLERANCE, IN.
FROM	TO	FROM	TO	
0	1	0	1	0.015
1	5	1	7	0.018
5	9	7	13	0.021
9	13	13	19	0.024
13	17	19	25	0.027
17	21	25	31	0.030
21	25	31	37	0.033
25	29	37	43	0.036
29	33	43	49	0.039
33	37	49	55	0.042
FOR EACH 1½ LB EXCEEDING 37		FOR EACH 2 LB EXCEEDING 55		ADD 0.001

hydraulic-press methods of fabrication. With proper control of stock volume, stock temperature, die temperature, lubrication, and surface condition of dies, die closure, length and width tolerances can be held to a minimum. We have set up controls to hold these factors to fairly narrow limits and hope to achieve still closer control of these variables in the future.

Deflection of dies and of the press bed will affect die closure tolerances; therefore deflection should be held to a minimum, not only to improve tolerances but also to prevent die breakage and damage to equipment.

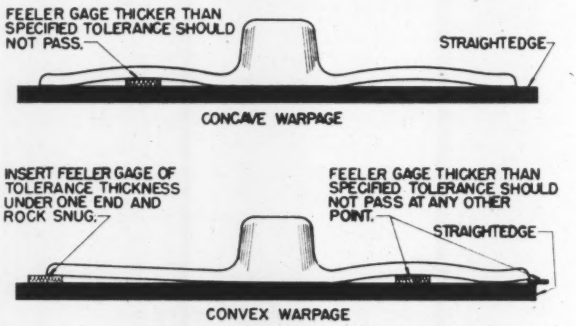
The control of mismatch tolerances must be given consideration. Factors affecting mismatch, especially on a nonsymmetrical forging, are necessary clearances between the ram and guides of the equipment, the variation resulting from die-sinker tolerances, and the differences in temperature between the top and bottom dies. Proper design, control in setup of dies in properly guided holders, improvement in die-sinking technique, and ways and means of establishing uniformity of die temperatures between top and bottom dies will all contribute in holding the mismatch tolerance to a minimum.

Forgings having thin webs and thin ribs, together with small draft angles, present definite problems in straightening. In producing such parts, warpage is apt to occur during the forging operation and during heat-treating. Relying upon die or hand-straightening, or a combination of both, we have found it difficult to hold such forgings to a very close straightness tolerance. The ejection from dies of thin-web forgings with small draft angles can result in distortion or even piercing of forgings.

Forgings having very small draft angles present a problem of removal from the straightening die and we may have to resort to the use of mechanical ejectors. Such ejection may cause a bow and we may have to hand-straighten after die-straightening. These problems which confront the forging producer will have to be worked out as we progress. They are not insurmountable and, perhaps after we have gained more experience along these lines, we will be able to produce forgings with thin webs and small draft angles within desired straightness tolerances by methods which will avoid the foregoing difficulties.

STOCK SELECTION, PREPARATION, INSPECTION, AND CONTROL

The stock employed for large hydraulic-press forgings comes from a number of other hot-working processes. Such stock includes rolled bar and shapes, rolled plate, extruded bar and shapes, and bar forged from ingot. The working of ingots by forging, employing a variety of working cycles, appears to be a desirable method of producing stock for large-press forgings. Sufficient working, along with the desired grain orientation, can be accomplished by utilizing such preformed or preforged shapes from ingot.


FEELER GAGE THICKER THAN SPECIFIED TOLERANCE SHOULD NOT PASS.
STRAIGHTEDGE
CONCAVE WARPAGE
INSERT FEELER GAGE OF TOLERANCE THICKNESS UNDER ONE END AND ROCK SNUG.
FEELER GAGE THICKER THAN SPECIFIED TOLERANCE SHOULD NOT PASS AT ANY OTHER POINT.
STRAIGHTEDGE
CONVEX WARPAGE

METHODS OF CHECKING STRAIGHTNESS FOR FORGINGS WITH CONCAVE AND CONVEX WARPAGE.

STANDARD STRAIGHTNESS TOLERANCES

LENGTH IN INCHES		TOLERANCE IN INCHES
FROM	TO	
0	9	1/64
9	18	1/32
18	30	3/64
30	45	1/16
45	60	3/32
60	80	1/8

FIG. 5 METHODS OF CHECKING STRAIGHTNESS FOR FORGINGS WITH CONCAVE AND CONVEX WARPAGE

The forging stock is produced under closely controlled practices, the details of which are beyond the scope of this presentation. However, great care is employed in ultrasonic inspection of forging stock, including the inspection of preformed shapes. It is important that forging stock be inspected to a high level of quality because the forging process will not change substantially the quality level inherent in the stock. It is important to the producer, therefore, to detect unsatisfactory stock and discard such stock at early stages of forging processing so that effort is not expended on poor-quality stock which ultimately might result in poor-quality forgings.

Intermediate or "in-process" inspection of forgings occurs between successive forging operations. This is a further safeguard of forging quality. Through these methods of control, it is believed discontinuities associated with ingot unsoundness have been largely eliminated. We have confidence that ingot and stock quality in the sizes required will not be a limiting factor in the production of large die forgings to be produced on 35,000 and 50,000-ton presses.

ALLOY FORGEABILITY

The relative forgeability of aluminum alloys affects the problems of production and, therefore, is directly related to the cost of such production. Fig. 6 shows relative forgeability of several commonly used forging alloys. Such curves are obtained through a measurement of the deformation of specimens with known energy absorption or through testing a tensile-impact specimen at modified elevated temperature. It will be noted that the relative forgeability improves markedly with an increase in temperature. The normal forging temperature for most alloys is about 800 F, cracking or rupturing occurring if the forging operation is performed substantially higher or lower than this value.

The forgeability of an alloy determines to a large degree the number of blocking operations required in order to attain a shape suitable for forging to size in a finishing die. Thus the more difficult an alloy is to forge, the greater the number of operations required to deform the forging stock sequentially to its desired shape. An alloy that is relatively easy to forge, such as 25S alloy, should require fewer operations and fewer dies than the same part forged in 75S alloy. Obviously, this has a direct influence on the cost of the finished forging. As a general statement, the higher-strength forging alloys have poorer forgeability than the lower-strength alloys. Therefore the forging designer should not specify an alloy of relatively difficult forgeability unless he requires the higher mechanical properties for that particular application.

DIE SINKING

Steel procurement and the sinking of large dies at present is, and for some time to come will be, a serious problem. At present we are having difficulty in obtaining sufficient die-sinking sources for our present requirements on the 15,000-ton hydraulic press. Die requirements for the 35,000 and the 50,000-ton hydraulic presses will be greater, so additional and larger die-sinking machines must be designed and built in sufficient numbers to provide for the necessary die requirements of forging producers throughout the country. It must be brought out that some forging designs could be of such a nature that 6 months conceivably could be required for the construction of a set of finisher dies only, assuming that a die-sinking machine is utilized 8 hr a day for 6 days a week. If the complexity of the design is such that two or more blocking dies would be required to produce the forging, it would necessitate a large die-sinking machine for each operational die, and the utilization of each machine would be consumed for practically 6 months. With all the aircraft companies going to larger and closer-toleranced forgings, it is apparent that a sufficient number of large machines will have to be constructed so that necessary die-sinking capacity will be available. This, added to the procurement time of die blocks, will extend delivery of forgings far beyond anything which we have known to date. The sooner dies can be designed and constructed for the large presses, the quicker we will all obtain experience in fabricating large forgings; and the sooner we design forgings for the large presses, the sooner machine-tool builders will design and construct machines for sinking large dies.

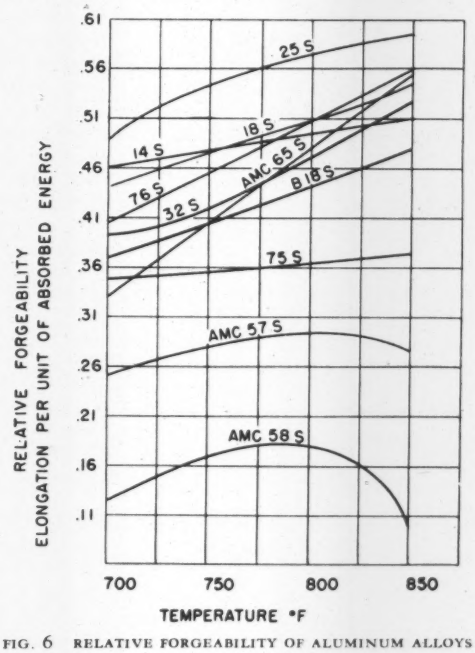


FIG. 6 RELATIVE FORGEABILITY OF ALUMINUM ALLOYS

Some consideration must be given to the quality of die blocks. Forgings with deep ribs or deep locks that extend to the center of the die blocks reach a portion of the steel that is not as sound as that which is within a few inches of the surface. The improvement of die-block quality can minimize die breakage, thereby contributing to the reduction of that hazard.

In an effort to obtain additional die sources, we expect to place on order four sets of cast dies with cavities cast in. We are going to conduct experiments in both cast steel and nodular iron, and as soon as these dies are received, we plan to evaluate the use of such cast dies, with the hope that it may result in another source for die material and also possibly a reduction in die-sinking time.

MACHINING

Probably some mention should be made here about the question of machining large forgings as there has developed a great deal of discussion on this general subject in connection with the heavy-press program. The remarks on the subject will be confined entirely to what has been called "in-process machining." Because even that term has been interpreted variously, consideration will be limited further to such intermediate machine operations as the forging producer may find practical and desirable in producing his finished forgings. It is not meant to include, for instance, the reduction of web thicknesses down to dimensions of 0.060 in. to 0.090 in. Such operations represent an entirely different problem which is in no way the subject of this paper.

By in-process machining, is meant, for example, machining operations necessary to reduce massive sections so as to obtain effective heat-treatment of 75S and 14S forgings to the T6 condition. The possibility is suggested of machining webs and fillets in boxed-in sections between forging operations in order to reduce unit pressures required in producing forgings to desired size. This might be economical particularly in short runs.

RESIDUAL STRESSES AND DISTORTION

The problem of unexpected changes in dimensions sometimes encountered during machining of aluminum-alloy forgings requires some comment. These changes are commonly referred to as distortion and they may cause airframe manufacturers trouble during extensive machining operations of large die forgings. Such dimensional changes may be due to localized overheating during machining of the part, redistribution or relief of residual stresses imposed during heat-treatment and, perhaps most important, exceeding the yield strength of the part by improper chucking or machining fixtures, or by exces-

(Continued on page 718)

The CURRENT STATUS *of* ENGINEERING SUPERVISION

By F. R. BENEDICT

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INDUSTRY now is beginning to feel the full impact of technical developments of the last war, and today we begin to recognize the unmistakable signs of a new era. In this new age management will run the full gamut in achieving economic objectives that are such an integral part of our industrial system. The applied technology that will be required to hold engineering position in industry is in a continual state of change, and careful evaluation indicates that industrial progress will require a higher proportion of engineers with advanced and specialized training, than has been required in the past.

Engineering supervision has the major portion of the load in applying and directing the technology that will enable business to meet its objectives in this new age of progress. The executive branch also must organize all levels of management so that planned objectives may be attained.

MANAGEMENT DEVELOPMENT

The business system involves the activities of people. Any person who is misplaced in the system is a liability—there are no exceptions! Management must initiate plans that, when properly executed, will result in the best utilization of the personnel within the organization, both management and workers.

A broad approach to this problem indicates that a comprehensive management-development program is an essential part of long-term business planning. It is logical to start execution of plans at the highest levels of the organization in order that the elements of execution may be passed down from one level of management to the next below, making it possible for the executive branch to evaluate the results of its planning at all levels. Four basic steps should be taken:

Organizational Needs Should Be Determined. The business must first establish that its organizational structure meets its present needs. To do this it must determine exactly what is required in each position. This analysis should include a description of each position, specifically defining function, responsibility, and authority.

Position requirements are an essential part of position description. Education, background, experience, specialized training, and personal characteristics required in each position should be established realistically. The personal characteristics required in a position for successful job execution are most difficult to determine and it must be recognized that a perfect combination of characteristics in one person is nonexistent. Each position requires heavy weighting in certain characteristics only and these weightings must be impersonally, yet accurately established, so that jobs may be filled from available candidates. Establishment of position requirements demands absolute impartiality.

Business Should Analyze What It Has. Successful operation and perpetuation of a business doesn't just happen—it must be planned. An essential element in this planning is the appraisal of the qualifications of its present management personnel with respect to adequacy in present position, deficiencies that should be remedied, and potentials that can be used to better advantage. A proper evaluation would point up a man's best results, best methods, and best personal attributes, as well as those which constructive action will help him correct. The facts, upon which such an appraisal is based, must be accumulated and judged by a group of impartial superiors who have intimate knowledge of the man and his work.

An appraisal is not complete without an objective review with the man being appraised. Good work deserves honest recognition; marginal or poor performance must be corrected. Counseling to improve areas of difficulty or omission is a most critical assignment and the problem must be handled honestly, objectively, and strictly on facts. It is our experience that supervisory counseling requires individual or group guidance and an appraisal program should include the development of counseling aids based on the best experience available in this field.

Latent management potential in the nonsupervisory organization also may be identified by appraisal. Such appraisal may well form the basis for selecting candidates for basic management training on a plant-wide scale.

Business Should Inventory Its Management Resources. The definition of positions and evaluation of personnel make it possible to inventory accurately the management assets of the business. With such material available, long-range planning is placed on a sound basis and reorganization and expansion to meet the needs may be carried out in an orderly manner. To assure the proper filling of vacancies that may occur in critical positions many companies use replacement tables which identify the best available replacement.

Business Must Activate a Program of Guided Development. The findings in the preceding steps will indicate both the strengths and weaknesses in management. As analysis is on the individual and his job performance, correction of deficiencies is naturally an individual action. Factual discussion with encouragement and planned guidance will nearly always result in an improved situation.

After an intensive period of research and trial the author's company placed in operation a management-development program based on the foregoing fundamental steps. The program was introduced over a year ago, and has been applied to all levels of management—covering more than 5000 individuals. Soon after being introduced it was realized that there actually were two steps to the program: (*a*) procedures and (*b*) follow through.

Management reflected a broad recognition of timeliness and value, and the individual response was enthusiastic and satisfying. Individuals welcomed the opportunity to define their responsibilities more specifically, and even more so to discuss their over-all performance with their superiors. The reaction pointed up the neglect of these basic management fundamentals

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and definitely indicated the need for follow through. We were at a loss to define clearly a program of follow through, until we realized that the appraisal reviews with each individual might provide such information, as each reviewer tried to develop the help that the individual desired from the company.

CLASSIFICATION OF INDIVIDUAL DESIRES

An analysis of our appraisal material gave us some surprising results. The individual desires classified as follows:

		Per cent
1	Guidance	31
2	Management training	28
3	Communications	17
4	Training in specific fields	10
5	Job rotation	5
6	Education	4
7	Special assignments	4
8	Public speaking	2
9	Technical societies	2
10	Suggested reading	2

The first three items, guidance, management training, and communication, cover about 75 per cent of the expressed need. While they indicate both individual and group need, they are the ones which most critically affect the supervisor in his job. We feel that we have a clear mandate to develop and supply material and techniques that will meet the indicated needs, distributing our effort realistically on the basis of the weighting factors.

From this analysis it is apparent to us that individuals want co-operative assistance and guidance in their problems.

We see too that they want to become more proficient in management. We are too prone to assume that good management techniques are passed down to job candidates from the supervision above, for this is not always the case. While experience is still a fine teacher, management cannot risk the placement of an insufficiently or improperly trained supervisor in an important position, for irreparable mistakes may be made in the first few weeks of job administration.

This survey also points up the fact that individuals want better communications, particularly in reference to policy matters. It is imperative that management policies be delineated carefully and a setup established to furnish all levels of supervision with the basic policies that they are expected to administer and to keep the supervisor up to date policywise through immediate notification as changes occur.

We have found that most of the less heavily weighted factors of need are really individual things that require doing in individual cases. Implementation of individual development on a company-wide scale would require the isolation of one "key common element" to direct our planning and action. We believe this key to be counseling and day-to-day guidance. We are studying this problem very actively at the present time with the idea of establishing uniform counseling aids that will apply throughout the corporation.

Training in management principles—for people already in management positions—is more applicable on a group basis. Our basic task is to prepare a program of administrative management dealing with fundamentals and functions of management such that it can be applied at the local level. Our studies so far indicate that case discussion techniques may aid the program materially.

The other factors are primarily those of individual need. Rotation, a method of guiding the work experience of individuals, should have definite objectives and a sound policy guide. We have established workable principles of rotation and currently are trying them out in one division by transferring nine men from their specialty to an entirely different function: for example—engineering to manufacturing, and so on. The results to date are very satisfying and there is a great deal of enthusiasm for it.

For many years we have had a Graduate Study Program in co-operation with leading universities, and more than 2700 have enrolled for advanced training, with over 250 going on to master's and doctor's degrees. This year the University of Pittsburgh accepted the challenge of developing a special course in business administration to be taught on an advanced basis for graduate engineers. Over 150 men, of which many are management people, are now in attendance. It is hoped that we may extend this program to all of the eleven participating universities in our graduate study program and believe that it might readily answer a widespread need in industry.

ENGINEERING SUPERVISION

In engineering, the supervisor has a number of attributes in common with the foreman in manufacturing: (1) He must weld a number of individuals, comprising different levels of age, training, and experience, into an efficient operating group. (2) He must get the work out. He accomplishes objective (1) individually within the confines of his own responsibility and authority; item (2) he does co-operatively, for a designer's work is not done until the design is manufactured and in satisfactory commercial service.

The line-engineering supervisor's main job is to plan and administer work patterns so that his engineering group produces to meet definite objectives.

A few of the major responsibilities that the supervisor must discharge successfully follow:

1 Evaluate and apply engineering manpower effectively.
2 Prepare work schedules.
3 Assign work loadings.
4 Evaluate current products and assist in selection of new products.
5 Plan minor and major development on current products.
6 Long-range planning—development leading to new and improved products.
7 Cost reduction on all products.
8 Design of current products.
9 Development on current or new products.
10 Administration of development funds for development under his responsibility.
11 Engineering verification of all projected commercial developments.
12 Customer order development—special designs—major modifications to meet customers' requirements.
13 Correction of field troubles.
14 Engineering assistance on application of product.
15 Prepare product and application information.
16 Prepare instruction books.

Probably the most important single element that first-line supervision has to contend with today is manpower and its proper application. While our management development program is designed to develop supervision at all levels we also are analyzing actively the problems of first-line supervison to determine what steps are necessary to more fully utilize trained engineering personnel. The current shortage of engineering graduates, coupled with the present high level of activity, makes it imperative that we exhaust every possibility for delegating routine technical and nontechnical effort of engineers to technicians and clerks, who are more readily available.

This problem was approached from an analytical point of view, taking one of our highly loaded engineering sections as an example, with the objective of establishing factual answers to the following questions:

1 What jobs or parts of jobs now done by graduate engineers

could be delegated to a clerk or nonprofessional technician with a net saving in the engineers' time?

2 How many man-hours of engineering time could be saved?

3 How many man-hours of supporting help are needed?

4 What are the training and experience requirements of that supporting help?

First, the entire engineering group was briefed on the purpose and procedure for the survey. Our objectives were twofold: (*a*) To prevent a bottleneck in engineering—but more important—to make it possible for the engineering department to spend the necessary time on design, refinement, and development of our apparatus; (*b*) to provide a more interesting and satisfying job for the engineer.

Information was collected for a two-week period, during which each engineer indicated the proportion of his effort that could be delegated to a technician or a clerk. The delegated activities then were analyzed to determine the number of technicians and clerks needed to absorb the delegated work properly. Technicians and clerks were assigned on a trial basis and actual savings in engineer time established. Our studies are not yet complete but preliminary evaluation indicates that attainable objectives lie between 15 and 30 per cent savings in engineer time, depending on the type of engineering operation under study.

From this simple but detailed survey we also developed basic training, experience, and personality requirements for the technician and clerical positions.

As a general pattern it would appear desirable to fill the engineering technician jobs with younger men (20 to 25 years old) who have taken the equivalent of at least two years of technical or college night-school work in engineering and who have demonstrated high intelligence as well as aptitude for both the physical sciences and the more practical technical subjects.

The element of technology also is beginning to affect our operations planning as many products now require more time and effort in their development and design, hence more careful scheduling and work loading. For some years we have been studying the role of computers in design work and have come to the conclusion that rapidly they will become (in many cases already have) an invaluable aid to the engineer in the design of complicated apparatus and systems. Our work has been with both analog and digital types and we believe that both are powerful tools for the rapid optimization of designs.

Five years ago it required weeks to obtain a shaft design (two-mass system) working longhand—today the design is optimized in less than a day and with a far more complete answer. A fifteen-mass system, an otherwise hopeless job, becomes practical and requires but a few days. Special-purpose computers will be applied directly in the design departments. This necessitates specially trained operators or regular engineering personnel trained in computer techniques.

The more complicated problems that involve large, costly, special automatic computing machinery, in most cases, will be handled in central facilities available to all design and development groups. While such facilities will be staffed with trained personnel, engineers using the facility must be trained in computer techniques. The widespread use of machines will simplify design scheduling and improve work loadings. The products will benefit directly through improved design excellence and in many cases lower design cost.

Small electric desk-type numerical calculators also offer great savings in normal design calculations, traditionally carried out by the use of the slide rules. When proper problem programming and use are taught they become powerful tools for the reduction of design time. While they are relatively expensive machines ($1200 to $2000) they normally pay for themselves in a few months through the saving of engineering time alone. With proper training, technicians can use these machines to great advantage in delegated calculation work.

SUPERVISORY PLANNING

In the discharge of his many duties, the supervisor must plan carefully every phase of his operations. One major element that he must contend with is paper work. In tackling the problem of simplifying the paper work, the system approach is the most productive of results. In an electrical system, components are connected by current-carrying elements; in an engineering system, components are connected by information-carrying paper work. An electrical system is adjusted by setting the components to transmit or receive just the right amount of electrical information (current, voltage, power, and so on) that is required—no more—no less; in a paper system the components are adjusted to transmit or receive just the right amount of information that is required—no more—no less. Today the common mistake is to study only a specific branch of the system, rather than the whole system. System engineering in the field pays real dividends.

In work planning and execution, a high level of co-ordination and co-operation is essential for harmonious relationships. A snarl-up in co-ordination usually reflects a lack of planning and often is detrimental to co-operation as necessary work loadings must increase rapidly to absorb the need. Poor co-operation is hard to detect, as it is usually individual with an individual, but supervision must find it and take action to correct it. Supervisors must be sure that their schedules and work loadings are realistic as fatigue is a critical element of co-operation that cannot be neglected.

CONCLUSION

While this paper has dealt with only a few of our most pressing problems, the author firmly believes that far greater benefits than we have experienced can be derived by further observations on our operations. Educated guessing has its place but it can lead to erroneous conclusions and wasted effort. Sound evaluation based on all available facts is much more productive of sound planning policies.

The status of engineering supervision is good—it will be better if we take the right steps in the right order. It will take time, it will take effort, but we believe it is worth a lot of both.

New Viscosity Standard

AS of July 1, 1953, the National Bureau of Standards adopted the value of 0.01002 poise for the absolute viscosity of water at 20 C as the primary standard for the calibration of standard viscosity samples and viscometers. The date originally proposed for this change was July 1, 1952; but, at the request of the American Society for Testing Materials and the International Organization for Standardization, the adoption of the new value for water was deferred for one year in order that the ASTM and ISO members could make the change simultaneously with NBS. The ASTM, the National Physical Laboratory in England, and the Physikalisch-Technischen Bundesanstalt in Germany have indicated that they will also adopt the value of 0.01002 poise.

Up to the present time the value of 0.01005 poise for the absolute viscosity of water has been used widely as the primary reference standard. The use of the new value of 0.01002 will result in a reduction of 0.3 per cent in the measured values of viscosity and will make viscosities reported in absolute units correspondingly more accurate. Previously published data based upon 0.01005 poise may be adjusted to the new standard by reducing the published values by 0.3 per cent.

ELECTROSPARK MACHINING

By C. R. ALDEN

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INTRODUCTION

THIS paper deals principally with the machining of conductive work materials by direct application of electric sparks. In true electrospark machining,[1] use is made of a circuit including both the workpiece and the tool as electrodes continuously spaced apart and mutually insulated from each other except during a high-frequency sequence of separate time-spaced unidirectional spark discharges caused to take place between them. Though spectacular results, pointing the way to achievements of the greatest commercial importance, have been accomplished, this has been brought about by increased attention to the detailed application of known principles. This paper is in no way an exposition of these details, which cannot as yet be disclosed for obvious reasons. It is rather a review of the progress which has been made in the direct application of electricity to work materials for machining purposes with emphasis on the potentialities of these processes for future development.

Removal of material from spaced electrodes as a result of a current passing between them was noted early in the arc light as an undesired concomitant to the creation of light largely by incandescence of the electrodes resulting from the heat liberated in continuous passage of current between them. Early applications of electricity directly to the working of materials are found in apparatus for reducing work material, in whole or in part, from the solid to the molten state. These include electric furnaces, electric-arc welding, and cutting devices.

A more nearly contemporary advance in the direct application of electricity to metalworking is found in the interrupted-arc devices having the workpiece as one electrode and the tool as the other.

Perhaps the best known, though by no means the only use of the interrupted-arc device, is in the disintegration leading to the removal of unwanted conductive materials in a workpiece such as broken taps or drills. It is customary in such devices to cause the tool electrode to vibrate longitudinally in relation to the unwanted conductive material briefly making contact therewith at the extremity of its approach stroke. At the breaking of each such contact, an arc is struck for a period which is terminated by increase of the separation of the electrodes to a distance through which the applied voltage is inadequate to maintain the arc. Within the time necessary to permit the electrodes again to contact, there is no arc between the electrodes. In such a device the several purposes of damping or extinguishing the arc, solidifying and washing out the particles of the electrodes dislodged therefrom, and preventing the otherwise inevitable build-up of heat on the anodic workpiece electrode, are accomplished by a continuous stream of a coolant (frequently tap water) which is circulated over the area in which disintegration of the work electrode is progressing.

Such a device as has just been described is frequently known by the descriptive name "arc drill." Though its use is by no means confined to the illustrative application described, it appears usually to fall in the category of a portable tool rather than a machine tool, and to date its best-known uses appear to lie in the field of salvage of jeopardized workpieces rather than in the routine production of them.

Recently, the direct application of electricity as an aid to cold or friction-sawing has meritoriously claimed increasing attention. Mechanically, such devices may closely simulate the well-known band or circular friction saw, modified to insulate the workpiece from the saw blade so that the former may constitute the anodic and the latter the cathodic electrode.

Such devices, in common with the arc drill, have repeatedly interrupted contacts between the electrodes which, when subjected to an adequate potential difference by being included in a circuit of adequate power supply, will occasion repetitive arcs effective either to melt or to soften the workpiece material so that it may be dislodged more easily and removed by the tool electrode which continues, in part at least, to perform the functions of a friction saw.

Because of the motion of the saw blade, the heat resulting from the frictional contact with the work and the repeated arcs between the electrodes is largely dissipated to the surrounding air or, in the illustrative instance of the arc drill, the electrodes may be flooded with a coolant effective to prevent deleterious temperature rise on either or both tool and workpiece. This coolant also may be ordinary tap water, or it may have either dielectric or electrolytic properties as desired.

Some experimental work has been done with equipment generally similar to the rotary friction saw with its disk blade replaced by a wider-faced conductive wheel generally similar to a grinding wheel or milling cutter, but made without abrasive grain or cutter teeth. It is said that when flooded with a suitable electrolytic coolant, certain combinations of wheel and electrode materials have been found highly advantageous in speeding the shaping of conductive materials not readily machinable by conventional methods.

A number of manufacturers of tool-grinding machines of the sort conventionally used for rotating grinding wheels, including diamond bort as the abrasive and used principally for preparing the cutting edges on tungsten-carbide tools, have revised their product to make the wheel the cathode and the work the anode in an electric circuit. When the electrodes are inundated in a suitable electrolyte, the grinding may be assisted electrolytically to such an extent that the duty of the abrasive material appears to be limited almost entirely to removal of particles of the matrix bond which remain after the tungsten carbide has been disintegrated electrolytically.

In fact, more advanced experiments have shown that when so electrolytically assisted, tungsten carbide may be cut advantageously by wheels, including domestically produced abrasives if these are held in a bond which has been rendered conductive by suitable additives.

The production authorities of the Federal Government have taken a tremendous interest in all methods by which more con-

[1] The mark "Method X" as used herein is registered by the Method X Company, a subsidiary of Firth Sterling Steel Company, owners of certain patents pertaining to the method and apparatus for performing electrospark machining. The exclusive licensee for the United States under these patents is Ex-Cell-O Corporation, Detroit 32, Mich.

Contributed by the Production Engineering Division and presented at a joint session of the Metal Processing Research Committee at the Spring Meeting, Columbus, Ohio, April 28–30, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

ventional grinding operations requiring wheels including diamond bort, or even wheels made of abrasives domestically produced but necessitating form-dressing by diamond tools, may be replaced by other methods of machining.

OUR DEPENDENCE ON INDUSTRIAL-DIAMOND PRODUCTION

The interest in such substitute methods has been increased greatly by the rapid increase in the use of jet aircraft engines requiring the inclusion of heat-resistant materials heretofore rated as unmachinable except by diamond wheels or grinding wheels required to be dressed by diamonds. It has been estimated that if we, as a nation, were suddenly faced with the necessity for all-out production of such engines, as we certainly should be in the event of a shooting war, the entire world production of industrial diamonds would be inadequate to our needs. This fact, plus any uncertainty of transoceanic shipment of diamonds occasioned by war conditions, immediately would assume the proportions of a national emergency.

It is established with ample clarity that the Russians, who possess no diamond mines and presumably have no reliable channels through which industrial diamonds may be imported, years ago turned their attention intensively to methods including those here discussed for largely putting an end to their reliance upon industrial diamonds. Whether or not the Russians are ahead of us in those refinements in electrospark-machining which make for highest achievable speed in metal cutting, coupled with highest achievable accuracy and highest surface finish in the workpiece, is not known. It appears certain, however, that they are substantially ahead of us in the extent to which processes of the sort described here are known and productively employed throughout their industry.

SUPERSONIC-VIBRATING METHOD OF MACHINING

Though the device next to be described briefly hardly falls within the category of machining by direct application of electricity to the work, a supersonic vibratory method of great interest for precisely machining hard materials has been developed.[2] Because of its indirect application of electrical energy, this method is capable of cutting nonconductive as well as conductive materials. Consequently, not only is it able to cut tungsten and other conventionally unmachinable carbides, but it has been widely used for cutting gem stones such as synthetic ruby for the preparation of jewels for watch and timer movements and other instrument uses, as well as many other conductive and nonconductive materials.

To do this, the workpiece is held on the work table of the machine immediately beneath a reversely cut intaglio die which is a negative image of the form to be cut in the workpiece. Both workpiece and die are inundated in a slurry usually of finely divided uniformly sized particles of boron carbide in water.

A transducer gives to the die a vibratory movement toward and away from the workpiece at supersonic frequency and of visually imperceptible amplitude. At its outermost extremity of movement, the die is spaced from the work by a distance less than the average size of the abrasive particles in the slurry. At its position of greatest retraction, the die is spaced from the work by a distance (a very few thousandths of an inch) adequate to admit new particles of abrasive. The die, which in operation never actually contacts the work, may be of a substance which is much softer than the workpiece and, of course, much softer than the abrasive particles which become charged into the surface of the die. Because there is greater movement of particles with respect to the work than there is with respect to the die, the rate of material removal from the work is greater than the rate of removal of material from the die.

[2] Cavitron Equipment Corporation, Long Island City, N. Y.

The process, in common with electrospark-machining, has the distinct advantage of enabling a carbide master workpiece to be cut from a freshly prepared die. As this workpiece will be an almost exact complement to the die when new, the original die when deformed may be reformed, or any reasonable number of new dies may be made by being coin-pressed into the the master workpiece.

Though the weight of the die and the problem of reciprocating it supersonically now limit its face to an area of some 2 × 2 in., the rate of cutting is quite rapid and the fidelity of image transference is high.

Each of the systems described in the foregoing differs importantly from electrospark-machining, and one of the purposes in reviewing them is to point up the differences from, rather than the similarities to, the Method X[1] system with which this paper principally is concerned.

DEVELOPMENT OF ELECTROSPARK PROCESS

Fig. 1 shows in simplest diagrammatic form a sparking system illustrative of the earliest of those used in electrospark-machining. Such systems are characterized by an energy storage source illustrated by the condenser C, which may be charged at a controlled rate from a source of d-c potential. The storage source has its positive terminal connected to the anodic (workpiece) electrode, and its negative terminal connected to the cathodic-electrode tool. The length of the spark gap can, of course, be regulated manually, but preferably spark-gap regulatory means, automatically and continuously performs this function.

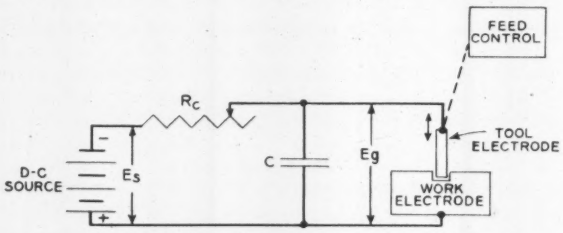

FIG. 1 DIAGRAM OF SPARKING SYSTEM, ILLUSTRATING EARLIEST KNOWN CIRCUIT USED IN ELECTROSPARK MACHINING

Means are provided for continuously maintaining at least the active portions of the electrodes inundated in a bath of dielectric hydrocarbon oil closely resembling kerosene or light fuel oil. Means also are provided for circulating the dielectric through the spark gap to flush continuously therefrom the particles of electrode material as rapidly as these are dislodged.

Upon energizing the condenser-charging circuit and the gap-regulatory means, the potential on the condenser normally will rise to a value adequate to break down the dielectric within the spark gap. If too widely spaced, the gap-regulating means will sense the resulting overvoltage condition at the gap and cause the armature of regulator motor M to move the electrodes more closely together. If the electrodes happen to be in contact or too close together, or bridged by particles previously dislodged from the electrodes, the resulting undervoltage condition at the gap will cause an increase in electrode separation. In short, the regulatory means, by constant adjustment of the spark-gap length, maintains within narrow limits a predetermined potential which must be applied to the gap to institute ionization or electrical breakdown of the dielectric.

When normally regulated, repetitive cycles of events occur in the system at high frequency, each cycle culminating in the passage of a spark between the electrodes. To facilitate understanding of the system as a whole, each significant portion of a

representative cycle will be discussed qualitatively, following which these will be related quantitatively in somewhat greater detail.

CHARGE ACCUMULATION

As the condenser is connected continuously to the charging source and the spark gap will later be shown to be substantially nonconductive following each spark, the condenser-charging period begins immediately upon termination of each spark discharge between the electrodes. The simplified schematic diagram in Fig. 1 omits certain controls of the charging current which are effective particularly in the early portion of the charging period. As to the schematic drawing shown, it will suffice to say that at any instant during the charge-accumulation period $Ic = (Es - Eg)Rc$ in which

Ic = condenser-charging current
Es = potential of source
Eg = potential at terminals of condenser and spark gap and also appears as a counter emf in charging circuit
Rc = resistance of charging circuit which in the presently simplified circuit may be considered to be without inductive reactance

At the beginning of the charging period the quantity Eg is substantially zero and, as a consequence, Ic then has its maximum value. As time permits the charge to accumulate, Eg asymptotically approaches Es, and Ic similarly approaches zero. However, if the spark gap is adjusted to its normal operating length, discharge of the storage means C will be initiated while the quantity Es-Eg still has an appreciable value. Termination of the charge-accumulating period is occasioned by initiation of the discharge period next to be described.

DISCHARGE PERIOD

As the potential Eg increases, the dielectric in the gap becomes more highly stressed. At a point in the rise of Eg the dielectric will be broken down electrically. At this instant the resistance of the spark gap, which had theretofore been substantially nonconductive, changes within an almost infinitesimal time to a value which is very low. To describe this change we say the gap has become ionized, thus rendering it conductive.

Immediately upon ionization of any path through the dielectric in the gap, the discharge rate therethrough becomes so great that the rate at which energy is admitted to the condenser via the charging circuit sinks into complete insignificance by comparison.

As a consequence, the discharge period is very much shorter than the charging period. The falling potential on the condenser quickly drops to such a value that ionization of the spark path through the dielectric cannot be maintained. The inundated gap then again resumes its very low conductivity, causing the discharge rate to become insignificant in relation to the current Ic, and a new period of charge accumulation is instituted.

The charging time will follow the basic equation $T = RC$ in which the time will be given in seconds if the resistance is expressed in ohms and the capacity in microfarads.

MECHANICS OF PARTICLE REMOVAL[3]

Though ionization of the gap has been described as occurring within an almost infinitesimal time, nevertheless it is a progressive occurrence and control of what happens in the time immediately following initiation of ionization has effects of the utmost importance upon the resulting electron discharge.

Regardless of the effective area of the spark gap, electrical breakdown of the dielectric is initiated at that point in the gap surface where the dielectric stress is greatest. Usually this is the point where the distance of separation is least. As the area of this point is substantially zero, the streaming of electrons and positive ions, from the dielectric material through this almost infinitesimal area, results in a current of very high density; this density is limited only by the availability of ions. Because the resistance of an ionized path through the dielectric is very low, the current density through this path is extremely high. Studies of the discharge made by scientists engaged in the development of spark cutting apparatus support a belief that this may be of the order of 100,000,000 amp per sq in.

The result of a rupture or electrical breakdown of the dielectric in the spark gap therefore is distinctly not a general ionization of the entire gap but is limited to a single path therethrough which is of almost infinitesimal area.

As a result of finite conductivity of the workpiece material a very high electric-field gradient occurs in the material of the electrodes about the points of impingement of the electric spark defined by the termini of this path of almost infinitesimal area. This field acts upon the positive ions of the material of the electrodes immediately adjacent the termini of the spark path. On the anode (workpiece) this material is placed in tension and, because the forces of the electric field exceed the rupture strength of the material, however great this may be, particles of the anode are torn off and move through the dielectric toward the cathode.

About the end of this spark path, which terminates at the cathode, the material is placed in compression by the electric field, particles do not experience the same tendency to be dislodged and, consequently, the material removed from the anode is greater in volume than that removed from the cathode.

Experience has made it clear that the almost infinitesimal time immediately following ionization of such a path through the gap is of the utmost importance in metal removal by the electrospark method and it is preferable to cause the electric discharge to have the highest possible intensity by completing it in the shortest possible time than to expend an equal amount of energy at a lower rate over a longer period of time.

All known methods of investigation which appear to be applicable support the conclusion that particle dislodgment is the result of forces mechanically applied. The effect of such heat as is inevitably associated with the passage of a spark which at most has a duration of from a fraction of one to a comparatively few microseconds, of itself has an entirely negligible effect upon particle removal. No evidence has been found that the removed particles achieve a temperature remotely approaching the molten state in process of removal. Photomicrographic studies of the workpiece surface show close agreement with surfaces fractured by mechanical means. None indicates the presence of heat as being contributory to the fact of particle removal.

After the resistance of the spark gap has been so greatly reduced as a result of initiation of ionization, every avoidable resistance or inductance in the condenser and its associated discharge circuit becomes important for the reason that resistance serves to limit the maximum current flow through the spark gap, and inductance serves to limit both the maximum current and the maximum rate $(dI)/(dt)$ by which this maximum current may be achieved.

FACTORS AFFECTING WORKPIECE ACCURACY AND SURFACE FINISH

The foregoing description has made apparent that, except for secondary factors which seldom assume controlling im-

[3] The explanation herein given in respect to this matter is, as of the date written, the one which appears to the scientists engaged in this development to be most consistent with the observable facts and most probably correct.

FIG. 2 IMPRESSION CUT IN PIECE OF TUNGSTEN CARBIDE BY TOOL ELECTRODE FORMED FROM BRASS NAVY BUTTON

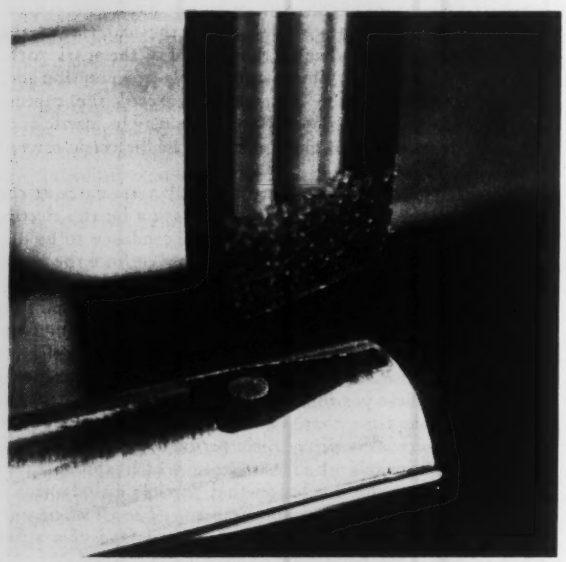

FIG. 3 KEY-SHAPED DEPRESSION SUNK IN WORKPIECE AND CLOSE-UP OF TOOL USED

portance, each of the successive sparks to cross the spark gap will take place across the then existing minimum gap length. This means that any desired form may be given to the cathodic tool electrode, and the form which will be cut in the anodic workpiece electrode will be complementary to an imaginary envelope thereabout and spaced from each element of area thereof by a distance normal to that area which is equal to the length of the spark gap. Obviously, therefore, as the gap length approaches zero, workpiece and tool approach precise complementarity. Practical limitations restrict the minimum gap length to about 0.001 in. To limit the operating voltage to safe values, the maximum gap length usually is taken about 0.020 in. In general, the operating-gap voltage is the product of gap length in thousandths of an inch by a constant $33^1/_3$ within this working range. When the intended gap length is known, the form of the tool may be compensated for the length of the gap.

The tool electrode may have any desired shape and, because the ionization of a spark path of almost infinitesimal area through the gap at any point reverses the sign of the quantity $(d\,Eg)/(dt)$, the possibility that sparks can pass simultaneously through more than one path at a time is precluded. Therefore the electrical characteristics of the discharge circuit are substantially independent of the opposed areas of the electrodes which coact to form the spark gap.

Therefore it follows that when the tool electrode approaches the workpiece along a line normal thereto, a reverse and substantially complementary image of the surface of the tool closest thereto will be cut in the workpiece and the precision of complementarity will be an inverse function of the gap length.

Fig. 2 shows the impression cut into a piece of tungsten carbide by a tool electrode formed from a brass button as used on uniforms of Navy enlisted personnel. Pressing dies for all manner of shapes may by this method be produced in any conductive substance irrespective of its adversity to machinability by other methods.

The first such die to be cut from a newly prepared tool may be retained as a master die for the reproduction of tool electrodes for reproducing the master in any conductive substance.

As there is at no time in the electromachining process any physical contact between the tool and the work, the hardness of the tool electrode is substantially of no consequence.

Because, at no time, is there contact between the tool and the workpiece, the machine, work fixtures, tool fixtures, and the work itself are completely free of all inaccuracies encountered in conventional cutting machines by the deflections as there are no cutting forces. This fact alone has a pronounced effect upon the cost of the machine-tool elements of the system.

There is a certain amount of deterioration of the tool form in use as a result, in part, of particles being dislodged from the tool by forces of the electric field and perhaps in greater part to erosion of the effective tool surface by particles dislodged from the workpiece which traverse the spark gap and impinge the tool surface.

Fig. 3 shows a key-shaped depression sunk in a workpiece together with a close-up of the tool used. To avoid dislodging more of the material than is necessary, the tool frequently is made hollow to be sunk into the work by a trepanning action.

As there is not the slightest necessity to rotate the tool except for threading and certain other undercutting operations, it readily can be of any desired transverse section including polygonal or irregular shapes, splines, gear-toothed sections, and so on.

A tool of form comparable with a bolt or stud which, when simultaneously rotated and advanced one pitch per revolution, may be used simultaneously to make and tap an internal thread in any conductive workpiece however hard.

Fig. 4 shows a piece of tungsten carbide, pierced, together with a tool electrode suitable for piercing such a hole.

Fig. 5 shows the dielectric-retaining portion of a Method

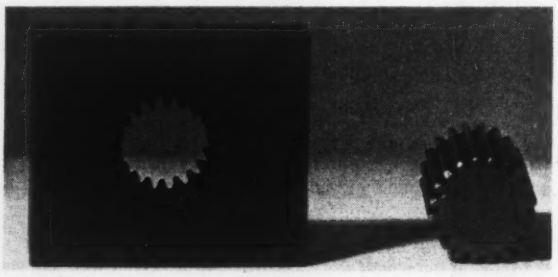

FIG. 4 PIERCED TUNGSTEN CARBIDE AND TYPE OF TOOL USED

X machine, including the means for mounting the workpiece which, in this instance, is a die-casting mold insert made of tungsten carbide. This shows also the tool electrode retracted vertically from its cutting relation with the workpieee. The tool is merely a replica of the piece to be made from the mold.

Each machine operates at a characteristic frequency of sparking and usually removes a substantially constant particle weight of the workpiece material per spark. As the effective electrode area has substantially no effect upon the frequency of sparking or the mass of particle removal per spark, the greater the effective electrode area, the slower the cutting will progress.

A machine, which unfortunately is not yet available commercially, consistently pierces a hole of 0.250 in. diam through tungsten carbide of 0.150 in. thickness in 15 sec with a trepanning tool of $^1/_{32}$ in. wall thickness.

Work-surface finish of the order of 26 microinches rms is possible at cutting speeds somewhat reduced from the maximum.

Special attention is drawn to reference (14) of the appended list of publications. This represents the latest known advance in the arts of more direct application of electricity to the machining of work materials.

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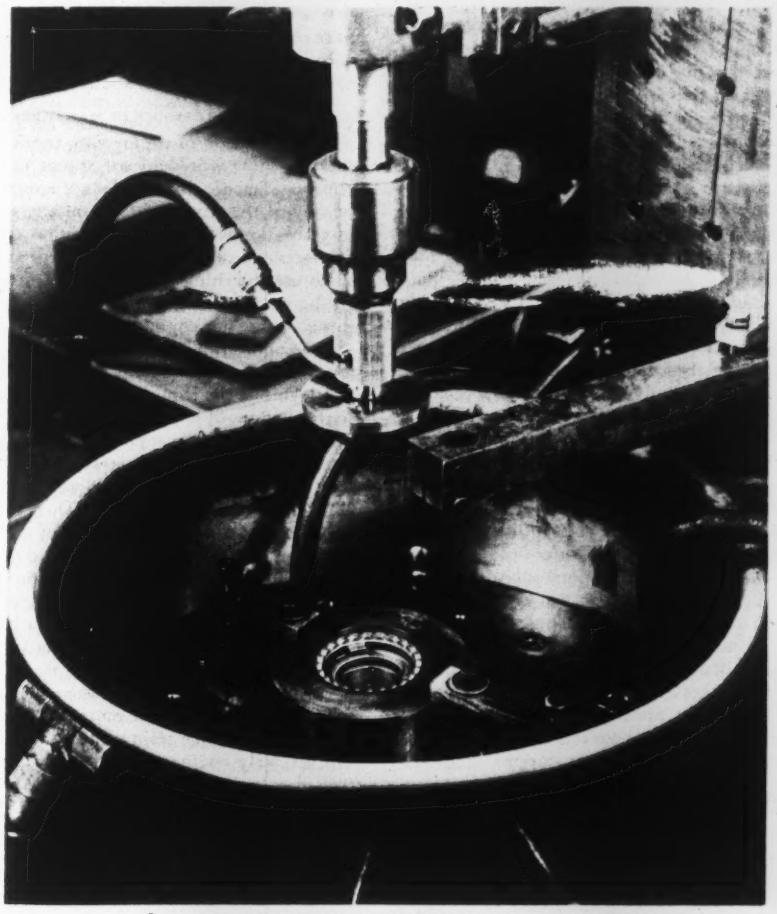

FIG. 5 DIELECTRIC-RETAINING PORTION OF METHOD X MACHINE

Intangible FACTORS *in* ENGINEERING MANAGEMENT

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DEFINITION—SCOPE

WHAT do we mean by engineering management? Webster defines engineering as "the science and the art of planning, constructing, and managing structures of various kinds." The definition of management that seems to fit our case best is "the act or manner of directing or carrying on." Combining these two definitions we may well define engineering management as "the act or manner of directing or carrying on the science and the art of planning, constructing, and managing structures of various kinds." For the purpose of this discussion we must narrow this field to "directing the art of planning structures."

Even this restricted definition of this subject encompasses a field which may be broken down in many ways. One phase of this subject is the organization of an engineering department. Others are functions of management; for instance, development of standards, estimating, scheduling, and so on. We might call such functions the tangible tools of engineering management. We will not discuss these. This paper will consider a few of the intangible factors in engineering management work.

EXCELLENCE IN ENGINEERING MANAGEMENT IS ESSENTIAL

In spite of what engineers sometimes think, top executives are people too. An executive does not like to upset the engineering department by canceling projects or changing schedules. Particularly, he does not relish having to dictate how the engineering department shall be managed. He would much rather have the head of the engineering department do the managing so that he does not have to worry about it.

In a successful organization there must be some very good organizers and managers at the top. Even these big men feel complimented when asked for advice or opinions. One responsible for running an engineering department can well ask his boss to go over the organization and the management machinery used. He either will learn a lot about management or the boss will be sure that the engineering manager knows his business. Don't wait until the engineering department is in so much trouble that the executive has to step into the situation and take over in order to straighten things out.

When engineering management does a good job of managing engineering activities, relations with top management are no problem. Engineers excel in design. As engineers, they are quick to appreciate good design. An executive excels in management. He quickly will recognize smart management in the engineering or any other department. No one can blame an executive, who knows that his engineering department is managed in a sloppy manner, for wondering whether or not the designs and estimates may not be just as sloppy.

ENGINEERING IS A SERVICE

An engineering department is a service department, even though it is an independent firm. An engineering department must be managed to provide the proper services when required. At times the work may come in "slugs," which makes it hard to manage the department efficiently. Growling about this problem will not solve it. Good managing is the answer.

No engineer would attempt to design anything without first finding out what it was expected to do. Likewise, an engineering department should be organized and managed in order best to fulfill its purpose. If the work load varies, this must be taken into account in setting up the organization and management methods. An individual engineer cannot be overloaded and still do good work. But it is possible to manage an engineering department to carry a variable work load.

Top management usually will not worry about engineering budgets in times when the department is busy; but good top management will cut overhead to the practical minimum when work is scarce. If the manager of an engineering department makes efficient use of outside help when work is heavy, and uses his own engineers to good advantage when work is slack, there will be little trouble about the engineering budget.

DEVELOPMENT OF MANAGERIAL ABILITY

In the definition of engineering the words "art and science" appear. These words do not appear in the definition of management. Science is knowledge, comprehension, and understanding of the truths or facts on any subject. Art is skill in using this knowledge. In a narrow sense, engineering deals with facts and things. We must depend on people to construct and to use the things we design, even though we as engineers may be willing to ignore our human relationships with each other in doing our engineering work.

So in engineering we must deal with people as well as with facts and things. Not only must people construct the things we design but the things must be designed so that people will use them and will want them.

But engineers are people too. Peculiarly, engineers themselves often give the impression that they do not consider themselves people, but are a different type of being to be treated as sort of a thinking machine. There is a basic reason for this anomaly and a full understanding of this reason is required for the proper organization and direction of engineering efforts, and perhaps many other scientific efforts.

It is safe to assume that most engineers are engineers because they like to develop, plan, and have a hand in building things. An engineering course in a good school is tough. A man would not stick to it unless he liked it. The engineer's training stresses the sciences on which the art of engineering is based as well as that art itself. He must study higher mathematics and other subjects which train his mind to think logically.

In his early engineering experience the need for accuracy is stressed. In short, the engineer's whole training and experience up to a certain point increase his natural preference for working with things rather than people, and make him abhor having to make any decision based purely on judgment. He wants time to figure each problem out to its completion, in as many different ways as his fertile brain can think up. He is likely to be unsympathetic when lack of time makes it necessary to do

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a job the way it was done last time. He wants to develop and use new ideas. He is disgusted when his advanced idea is discarded because those who are to use it want something "they know will work."

He may not try to understand why a project on which he has worked hard for months is shelved or radically changed. He may think he is being kicked around. In short, the engineer's education, training, and early experience tend to dull any degree of broad viewpoint, judgment, tolerance, and understanding which may have been present in his natural make-up.

The older type of engineering organization, which is still used to a great extent, makes this tendency worse. Reference is to a highly departmentalized organization based on principles that, while theoretically efficient, do not take into account the fact that engineers are people. Engineers must be given some managerial experience or they cannot advance far in their profession. A taste of the managerial side, such as being in charge of a project, however small, will help the man decide whether or not he really wants to be a manager.

A good engineer is inherently a builder. He is proud when he sees something built from his plans or ideas. Not only does he see it, but so do others. All human beings crave such personal satisfaction. But the manager has to obtain it in a less impressive manner. The manager seldom can point to anything physical as something to which he personally has contributed.

The engineer whose inclinations, education, training, and early experience make him logical in his work, lives in a world of people who are not very logical. In spite of his technical background, his own reactions to things that please or irk him are just as illogical as the reactions of other people.

Many engineers feel that their profession is not properly recognized. Actually, the public regards engineers quite highly. The engineer often fails to understand peoples' motives. They do not always do what his logic shows is best and he doesn't see how they can be so dumb. This misunderstanding may affect his financial and social rewards adversely. Committees for advancing the engineer's professional standing might consider this possibility.

One of the quickest ways for an engineer to gain recognition is to concentrate in a relatively narrow field and become an authority in that field. But one who takes this road to recognition should realize that it does not lead to a managerial position.

There are many cases where a chief engineer was selected because of his engineering eminence, with little or no thought given to his managerial qualifications or experience. Such a man must realize that management is a new profession which he has to learn. Otherwise he will find himself bogged down with detail, unhappy, and probably not doing a very good job. His organization may have traded a good engineer for a lousy manager.

We should direct engineering efforts so that it is not necessary for a man to specialize in order to gain fame. Someone said a specialist learns more and more about less and less until he knows everything about nothing. If possible we also should have a few spots for the man who elects to specialize and gain recognition by being an expert.

An engineering department must be organized so that the man at the top need not learn less and less about more and more until he finally knows nothing about everything.

BASIC PRINCIPLES OF MANAGEMENT CAN BE APPLIED TO ENGINEERING

Judging from discussions in which the author has participated, the engineering profession subconsciously resents conforming to basic principles of management. When talking about estimating, scheduling, budgeting, and the like, engineers seem to feel that engineering is different and should not be expected to abide by rules set up for others. If this is true, engineering cannot be managed in the same manner that other activities are managed.

Surely no engineer would use a bridge for a turbine foundation, but he would not set out to develop a whole new set of basic principles to design a turbine foundation. He simply would apply the same principles of stress, deflection, vibration, and impact that are used in bridge design to his problem of designing a turbine foundation.

Likewise, basic management principles are applicable to the management of an engineering department. Of course they must be applied properly to take care of the particular situation.

MANAGEMENT AND ENGINEERING ARE SEPARATE PROFESSIONS

Although we apply management principles to the management of an engineering department, management is not strictly an inherent part of engineering technology. It will be recalled that we had to build a definition for the term "engineering management" by combining the definitions of "engineering" and "management."

Our broad definition of engineering includes "managing." But the training and experience of most engineers neglects this important phase. Broadly speaking, management is a profession in itself, even though management by definition is one of the phases of engineering.

As pointed out previously, engineers deal primarily with facts and things. On the other hand, management deals primarily with people. Sometimes a manager must make decisions without clear-cut facts.

No conscientious engineer whose training and practice had been confined to electrical engineering would attempt to design the turbine foundation previously mentioned, using the principles of impedance, power, and so on, with which he was most familiar. If he had to design the turbine foundation he would learn the proper engineering principles before he tried to do it. But for some reason or other, many engineers seem ready to embark upon any problem of management without making any study of the basic principles of management.

An engineer who has ambitions in the field of management or who aspires to managerial responsibility in engineering should realize the need for serious study of the principles of management.

ENGINEERING ECONOMICS MUST BE PRACTICED IN ALL PHASES OF ENGINEERING DESIGN

Too often the economics of a project are considered only in the study stage. Engineering management must show all engineers how to apply engineering economics to all phases of design, including detail design. Not only must this instruction be given, but it must be stressed continuously.

The engineer usually is an idealist. He must be taught that excellence alone is not an end in itself. Improvements must be justified economically. It is not enough that they simply improve efficiencies. Sometimes we spend dollars in order to save nickels.

Any design should start with the simplest and cheapest arrangement which will produce the results desired, regardless of efficiency. Each refinement and addition must save money by increased efficiency, lower maintenance, labor saving, or some other factor. This subject of engineering economics certainly is one of the principles of engineering. It is a part of the art of planning structures of various kinds. Engineering management must make sure that engineering economics is practiced just as faithfully as any other engineering principle.

Personally, the author knows nothing of product design, but it may be that the same economic principles apply. Here, sales appeal is another economic factor which justifies refinements and increased cost.

CHANNELS OF COMMUNICATION

Engineers must develop a broader understanding of the problems in other departments. They must be informed why projects are changed, rushed, or canceled. They must know the reasons behind decisions which look peculiar from a purely engineering viewpoint. This will help them understand the other fellow—including the boss.

The head of the engineering department is the only person who can do much about this. It is one of the many reasons why he should not be burdened with a lot of detail. The only channel of communication between engineering personnel and top management is through the head of the department. It is his responsibility to see that this channel of communication is kept open. It is not usual that top management objects to keeping this channel open. When it is blocked it is usually because the head of the engineering department is so snowed under that he does not have time to explain the why of things to department personnel.

Naturally there are some situations which it is unwise to discuss. But if the general practice is to tell the engineers why, they will accept a decision without question when it is explained to them that the reasons are confidential.

Channels of communication with other departments do not necessarily have to pass through the head of the engineering department. But it is up to him to see that these channels are kept open. He must encourage his men to keep an open mind and to give full weight to the opinions and requests of others. He must teach them to present their own recommendations as fully as necessary, and in a manner which shows sincerity rather than stubbornness.

RESPONSIBILITY OF ENGINEERING MANAGEMENT TO ENGINEERS

In any endeavor, management must go farther than to establish policies, give instructions, and insist on results. Employees have a right to expect management to feel a keen sense of responsibility toward them. On tough and unusual problems, either in engineering lines or even personal matters, there is often no place to turn for help except to the boss. Those in management must be willing and able to help. Needless to say, management should make decisions promptly, when analyses and recommendations are presented.

It does not take a great deal of imagination to look at management itself as a service. The managers themselves do not make the product, whether that product be services or goods. The service they perform is to guide and direct their people so that they can accomplish the most and get the greatest amount of satisfaction from the accomplishment.

The engineering management has a respons bility to the men in that department to manage engineering activities in a way that will merit the high regard of top management and others. If the department is held in high regard the individuals in that department can more easily win respect. Among the many things necessary to fulfill this responsibility are the following:

(*a*) Operate the department so that it can provide any required type of service promptly and economically.

(*b*) Insist that engineering economics be practiced in all phases of design.

(*c*) Keep lines of communication open so that engineers may develop a broader understanding of the other fellow's problems.

(*d*) Help those who show a real liking for managing to develop latent managerial ability.

(*e*) Relieve those in responsible charge of engineering and those who prefer strictly technical work from as much administrative detail as possible.

(*f*) See that administrative details are given as careful attention as engineering details.

CONCLUSION

It is not particularly difficult to apply all these things to the management of an engineering department. It may be necessary to make some changes from the old style of highly departmentalized department, but this has been done in a number of cases.

In fact, half the job is done when not only those managing the engineering department, but others in the department realize these factors exist and resolve to do something about it.

It is certain that when the excellence of the engineering profession in managing engineering activities is equal to the excellence of the engineering designs produced, the profession will be held in much higher regard than it is often held at present.

Wanted: A Centripetal Professional Force

AS THESE words are being written, the American Medical Association is holding its 102nd annual meeting in New York City. More than sixteen thousand physicians are in attendance to hear some four hundred technical papers scheduled for presentation.

Why mention this in a publication whose readership is predominantly made up of engineers? If one considers the current state of organization, overorganization, and disorganization of the engineering profession the answer will be apparent.

Last September the American Society of Civil Engineers celebrated its Centennial with a mammoth intersociety meeting in Chicago. Looking back to a realistic appraisal of that meeting reveals an almost incredible fragmentation of the engineering profession. Indeed, it would be difficult to find a better example of the growth of professional provincialism and narrow specialization.

How can one explain the contrastingly different roles that the AMA and the ASCE have come to assume in their respective professions? Actually, both societies had their origins at about the same time in the mid-nineteenth century and benefited by reasonably comparable advances in their basic underlying scientific disciplines. Yet despite the rapid growth of medical specialties and the divergent forces that such interests must have imposed upon the structure of the AMA, that society has continued to exert leadership for the entire medical profession.

On the other hand, the ASCE which originally represented *civil*, as contrasted with *military* engineering, continued to represent one specialized field while innumerable other specialized societies sprang up over the years. This is not meant as a criticism of the ASCE but rather the trend in the engineering field.

Today the engineering profession might be compared to a rotating machine that is badly out of balance. The centrifugal forces of narrow specialization and the inertia of vested society interests have gotten out of hand. Engineers know what to do to bring the machine into balance. Somehow they must find and muster the strong and effective leadership that can create the centripetal forces out of which an effective unity organization can grow. (Editorial from *Combustion*, June, 1953.)

METAL-CLAD LAMINATES *Used in* PRINTED CIRCUITRY

By NORMAN A. SKOW

DIRECTOR OF RESEARCH, SYNTHANE CORPORATION, OAKS, PA.

A printed circuit is a metal reproduction of a conductor pattern which has been bonded to an insulating material. Serving as a conducting medium in electronic assemblies, such circuits replace to a large extent the internal maze of wires normally found in conventionally assembled equipment.

Printed circuits have been achieved by plating metal patterns on plastic boards, by spraying metal into depressions in a plastic plate, by bonding rigid wiring harness to a plastic base, by fusing silver-ink patterns on ceramics, or by etching of metal-clad plastics. The latter method is currently gaining in popularity and seems to be admirably suited to mass-production-assembly procedures required in the highly competitive electronics industry.

The simplicity and uniformity of printed circuitry offers tremendous economic advantages in the production of all types of electronic equipment. Elimination of manual wiring speeds assembly and, because mechanical reproduction reduces the probability of error, inspection time is shortened automatically while assemblies become more uniform and reliable.

MATERIALS

The electrical properties of printed circuits are largely determined by the base laminate, the metal foil, and the adhesive used to bond the two. For most printed-circuit applications, copper foil in a variety of thicknesses is bonded under heat and pressure to one or both sides of thermosetting laminated sheet stock of the desired grade and thickness.

Numerous experiments have been made to determine the suitability of copper, aluminum, brass and silver foils. Of these, copper has been the most widely used; however, other metals are rapidly gaining in popularity. Silver and brass possess excellent current-carrying characteristics but suitable adhesives have not been developed which can produce a bond sufficiently strong for most service conditions. On the other hand, aluminum bonds well but poses a number of problems in soldering techniques. A partial solution to the soldering difficulty has been found by using a thin layer of copper or tin alloyed to one surface of the aluminum foil.

For printed-circuit applications, electrolytically deposited copper foil is preferred over that produced by the time-honored rolling method. Rolled copper is undesirable for the following reasons:

1 Insufficient width. Rolled foil is too narrow (6 to 12 in. depending upon thickness) for efficient and economical bonding practices.

2 Rolling operations generate considerable heat which sometimes produces burned spots in the foil.

3 Rolled copper is likely to contain or pick up traces of other metals which might influence the accuracy of etching. Such a condition also could interfere with the production of the extremely fine lines required for certain circuits.

4 Lubrication applied during rolling operations tends to reduce bonding properties of the adhesive. The result is a non-uniform bond of foil to the sheet of dielectric.

None of the drawbacks mentioned apply to electrolytically produced copper foil which is practically pure and is available in various thicknesses and widths up to 64 in. Although this process was developed long before the advent of etched circuits, full advantage is taken of the fact that foil thus produced is admirably suited for this purpose. Electrolytically deposited as a thin layer on a smooth, revolving lead drum, a foil is stripped off which has one extremely smooth side while the other side is relatively rough. This smooth side permits uniformity of etching while the rough side becomes an ideal surface for bonding.

Thin copper sheets used in the building trades are also produced by the electrolytic process but quality control is much more rigid for grades which ultimately will be used in printed circuits. Each roll is inspected for the pits, scratches, wrinkles, nodules, or pin holes which will render it unsuitable for electronic use. Extreme care during handling also must be observed because oxidation resulting from fingerprints allows these areas to etch at a different rate of speed from that of unoxidized areas. For printed circuits foil thicknesses of 0.0014 in. and 0.0028 in. are most commonly used.

The most satisfactory printed-circuit dielectric or insulating materials developed thus far are the thermosetting laminated plastics. Any of the twenty-odd standard grades of thermosetting laminated products described in NEMA "Standards for Laminated Thermosetting Products"[1] will produce a satisfactory bond with copper. The most generally satisfactory insulating or dielectric material in use today is NEMA Grade XXXP. This thermosetting laminate utilizes a paper filler and is produced, as are all laminates, by impregnating or coating the filler material with a thermosetting resin and consolidating a predetermined number of layers under temperature and high pressure. The ensuing chemical reaction transforms the layers into a hard, dense solid which will not delaminate and cannot be resoftened by the application of heat. Even in thin sheets, XXXP grade combines excellent electrical properties with the good machinability so necessary for punching operations. In addition, this laminate is sufficiently hard to maintain a smooth surface after the metal foil has been bonded.

Laminates other than phenolics, such as melamine and silicone, also may be used. Melamine resins are used where arc resistance is an important factor, and silicone resins are used when heat resistance is required. Flame-retardant additives may be incorporated into most of the thermosetting resins and these tend to increase the resistance of the laminate to flame.

Contributed by the Rubber and Plastic Division and presented at the Spring Meeting, Columbus, Ohio, April 28–30, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[1] NEMA, publication No. LP1, 1951. National Electrical Manufacturer's Association is a nonprofit trade association of manufacturers of electrical apparatus and supplies. The "Standards" publication is largely the result of co-operative work with the military services, particularly the Bureau of Ships of the Navy Department. It presents a simplification of test procedures and standards and emphasizes the properties vital to each grade.

It is important to select additives which do not detract from the electrical and mechanical properties of the laminate. Standards have not as yet been established for flame-retardant tests.

BONDING

A great number of proprietary compounds are available for bonding metal foils to base laminates. These compounds include phenolic, melamine, urea, and vinyl resins. Adequate bonding, however, is a formidable problem. The proper adhesive must be sufficiently strong, must possess good heat resistance to permit soldering without blistering, be resistant to shock and moisture, and must at least match the laminate in electrical properties. Thermoplastic adhesives are characterized by their susceptibility to blistering during soldering operations and also have too much cold flow under normal operating conditions. On the other hand, common thermosetting adhesives do not possess the required shock resistance and do not bond the copper foil as well as desired. This problem has been solved by developing specially formulated mixtures of both thermosetting and thermoplastic resins. A typical example of such a formula[2] is made from a mixture of phenolic and vinyl resins.

The actual mechanics of bonding foil to a laminate may be accomplished by one of two methods. Class 1 copper-clad laminate is produced from a predetermined number of resin-impregnated sheets to which is added a thin dry sheet of adhesive film followed by a sheet of copper foil. The entire build-up is then subjected to heat (approximately 320 F) and high pressure (approximately 1000 psi) for one hour. If desired, the adhesive film and foil may be added to both sides of the build-up.

Class 2 copper-clad laminate is designed to meet closer thickness tolerances than Class 1 material. It is produced by sanding a finished, cured sheet of laminate to the desired thickness, after which the adhesive and copper foil are added. It is then returned to the press for a second application of heat and pressure. Because of the additional work involved, Class 2 material is more expensive than Class 1.

After bonding, copper-clad sheets usually are sprayed with a strippable plastic film for protection against scratching, oxidation, and scarring during subsequent trimming, packing and shipping operations.

PROPERTIES OF COPPER-CLAD SHEETS

The principal requirements for finished sheets of foil clad laminated materials are their ability to resist peeling, and resistance to heat and moisture. Other important considerations are that the copper surface be substantially free of wrinkles, pits, nodules, scratches, pin holes, and oxidized areas. It must be uniformly thick; otherwise it would be impossible to etch to fine lines. The copper also must be relatively soft in order to retain proper punching characteristics.

The adhesive layer must possess good electrical properties and be resistant to moisture. When bonded it becomes an integral part of the sheet of dielectric and must match the selected grade of laminate in NEMA characteristics.

A quality-control check on the laminate is made to determine the water resistance and dissipation factor at 1 megacycle after immersion in water for 24 hr at room temperature. These tests are made according to procedures designated by ASTM.[3]

Bond strength varies with the thickness of the copper. For copper 0.0014 in. thick the bond varies from 3 to 5 lb. For copper 0.0028 in. thick the bond varies from 4 to 6 lb. The bond-strength test is made as follows: Four specimens, two in the lengthwise direction and two in the crosswise direction, each 1 in. × 4 in. × thickness, are cut from a sheet. The copper foil is peeled back from one end of the specimen approximately 1 in. so that the line of peel is perpendicular to the edge of the specimen. The specimen is then supported in a horizontal plane with the peeled copper strip down between two solid supports adjusted to provide a $^3/_4$-in. span. The end of the peeled strip is clamped between two knurled jaws to which is attached a light container. The jaws must cover the full width of the strip and are clamped parallel to the line of peel. Sand or lead shot is poured at approximately 2 lb per min into the container until the strip begins to peel and at that point the weight of the total load is noted. Average value for the four specimens is the bond strength of the composite sheet of surface tested.

The heat resistance of the copper-clad laminate is determined by two tests—the oven test and the hot-solder test. When the material is subjected to an oven temperature of 250 F for 30 min no blistering should occur. This test is conducted by supporting an unconditioned specimen 6 in. × 6 in. in a nonmetallic rack in a horizontal-flow air-circulating oven maintained at 250 F ± 4 deg F. Examination of the specimen after 30 min should reveal no blisters.

The hot-solder test is accomplished by floating a 1-in. × 1-in. unconditioned specimen (copper side to be tested down) in clean molten solder at a temperature of 400 F. When the material is

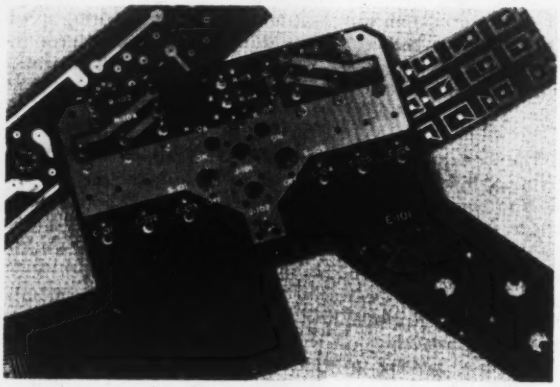

FIG. 1 ETCHED PATTERNS OF PRINTED CIRCUITS ARE EXTREMELY ACCURATE REPRODUCTIONS OF THE ORIGINAL DESIGN
(Fine lines or complex shapes can be reproduced indefinitely without variation or loss of detail.)

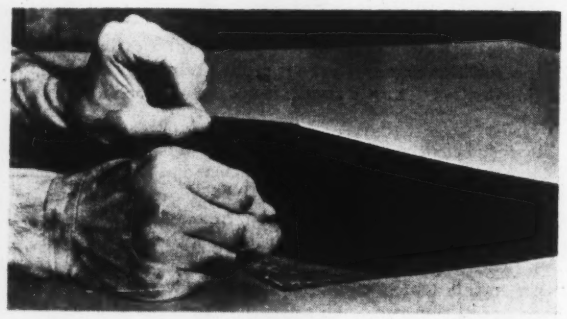

FIG. 2 MAKING UP FOIL-CLAD LAMINATES
(Make-up for each sheet of foil-clad material consists of arranging laminate, adhesive, i.e., dry film in this instance, and copper foil in proper sequence. Adhesive must contact rough side of both laminate and foil for best possible bond.)

[2] Armstrong Cork Company, product No. 21013.

[3] American Society for Testing Materials: Water-absorption test, ASTM-D-229; Dissipation-factor test, ASTM-D-150.

FIG. 3 STACKING MAKE-UP FOR BONDING

(Make-up for each sheet of foil-clad is sandwiched between clean, smooth steel press plates. These assemblies are then stacked five high, called a "pack," for insertion in hydraulic presses where bonding takes place under heat and pressure.)

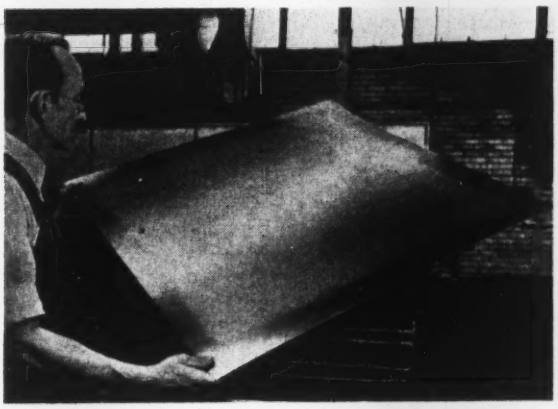

FIG. 4 AFTER BEING REMOVED FROM LAMINATING PRESSES, EACH FOIL-CLAD SHEET IS INSPECTED CAREFULLY FOR FAULTS, PRINCIPALLY BLISTERING, CRACKS, OR IMPROPER BONDING

subjected to the hot solder for 10 sec no blistering should be evident.

Foil-clad laminates meeting the foregoing specifications have proved to be eminently successful for practically all types of printed-circuit applications.

ETCHING

Etching chemicals vary with the foil. For copper and brass, 38 to 40 deg Baumé ferric-chloride solution is used; for aluminum, 10 per cent hydrochloric acid; for silver, 30 per cent nitric acid. These solutions are normally used at 85 to 95 F.

Etching time varies with the equipment used. In paddle-type etchers, cup-shaped paddles on a rotating shaft pick up the etching solution and coat the surface to be etched with a fine spray. Using this method, copper foil 0.0014 in. thick will be etched through in about 2 min. The number of plates which can be etched at one time in a paddle-type etcher is limited.

Tanks are more practical for mass production. The etching

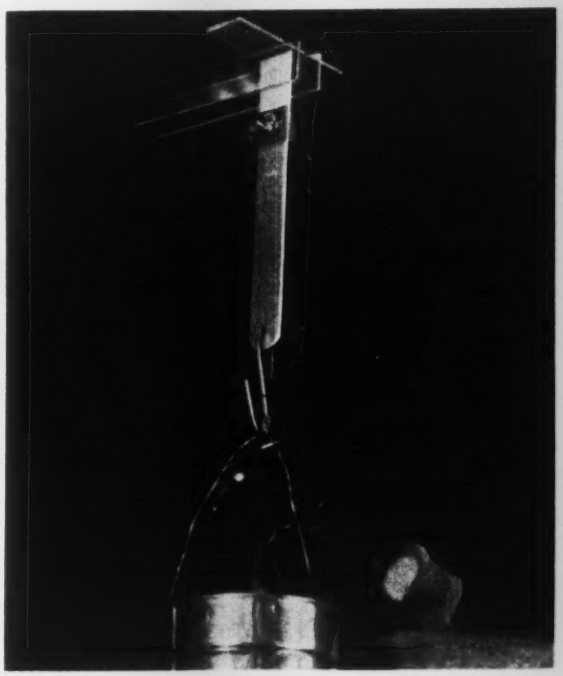

FIG. 5 FOIL PEELED FROM A TEST STRIP IS SUBJECTED TO A STEADILY INCREASING PULL FROM A SUSPENDED LOAD

(Bond strength is computed from weight of load required to cause further separation of foil from laminate.)

solution is placed in a suitable tank and agitation is provided, usually by compressed-air jets. The sheets to be etched are either racked or hung in the tank or carried through the tank by a conveyer. Etching time for copper foil in this sort of equipment will vary from 10 to 20 min.

In any type of printed-circuit etching where quality and consistency are important, a careful control over solution concentration, temperature, and degree of exhaustion must be maintained. Timing is important to prevent overetching and excessive undercutting of the resist.

FABRICATION

In general, foil-clad laminates may be fabricated with the same machinery and methods used for sheets without the foil. Shearing and sawing offer no additional complications. Special care must be taken in the design of progressive piercing and blanking dies so that the stripper plate will prevent any lifting of the foil as punches are withdrawn. Drills should be sharpened with a negative rake similar to that used when drilling aluminum. When so ground, they will not catch the foil and lift it away from the laminate when holes are drilled through a narrow line of metal or at the termination of a line.

Rapid punching in exact register with the etched pattern is really the only difficult fabrication problem to be met. No general solution exists, however, since each printed circuit is of a different size and shape and the method of handling will depend on the type of tools required, the length of the strips, and a number of other factors.

ASSEMBLY

Methods of assembly of printed circuits into finished electronic or electrical devices are as varied as the applications.

(*Continued on page 714*)

AIR-POLLUTION ACTIVITIES

What Universities, Colleges, Research Institutes, and Laboratories Are Doing

AIR POLLUTION CREATES SERIOUS PROBLEMS

LIKE many similar nondefense activities, research on air-pollution problems decreased to a marked degree during World War II. Following the war, interest in the subject was resumed only slowly. However, widespread attention was attracted to the problem of atmospheric contamination after the Donora smog episode of October, 1948, which resulted in some twenty deaths.

Previously the only similar incident for which there is a record took place in the Meuse Valley in Belgium in 1930, when a period of intense fog resulted in the death of sixty persons. In November, 1950, a serious exposure to an accidental escape of hydrogen sulphide in Poza Rica, Mexico, caused twenty-two deaths. More recently, the past winter brought prolonged and intense fogs to Europe and, in particular, to the London area where, it is claimed, over 4000 deaths were precipitated.

SUBCOMMITTEE STUDIES PROBLEM

These occurrences, plus a wide variety of local problems, have served to increase activity on air pollution, its causes, effects, and control. Public, governmental, and industrial interest have stimulated research programs in a large group of agencies, including the universities, colleges, and institutes. This report presents a summary of air-pollution research in a group of institutions in this country and Canada which have replied to a recent questionnaire. No pretense to complete coverage is offered, but it is hoped that the reader will call to the attention of the Executive Secretary any omissions. The committee plans to issue at suitable intervals revisions as a continuing activity. Subsequent reports in this series will present results of questionnaire surveys of the official agencies, of the control-equipment manufacturers, and of industry as a whole.

The list of institutions covered by the questionnaire was compiled from a number of published sources as well as from the personal information of the subcommittee members. Informative answers were received from 37 institutions; 13 indicated no activity in air-pollution research, while 7 failed to reply. An effort was made to direct the questionnaires to persons known to be active in air-pollution research. Where this was not known, the communication was addressed to the institution. In some of the latter cases, the questionnaire may have failed to reach an informed source. Researchers are requested to supply details which can be included in the next report.

One of the seven objectives in the program of the ASME Committee on Air Pollution Controls is . . . "to provide a clearing house for information on control projects and trends." To carry out this task a subcommittee consisting of the following persons was appointed:

H. B. Lammers, Chairman; Coal Producers Committee for Smoke Abatement

L. C. McCabe, now replaced by R. C. Corey; U. S. Bureau of Mines

C. A. Gosline, now replaced by L. L. Falk; E. I. du Pont de Nemours & Company, Inc.

W. A. Schmidt, Western Precipitation Corporation

A. C. Stern, New York State Department of Labor

By means of questionnaires, this group is collecting information on air-pollution activity among a variety of organizations. The ultimate application of the material will be to encourage co-ordination of effort. The present report, based upon information received from inquiries directed to universities, colleges, research institutes and laboratories, is the first of a series of publications by this subcommittee. Inclusion of an institution does not imply approval or selection by the ASME.

Frederick S. Mallette,
Executive Secretary,
ASME Committee on Air Pollution Controls

TABLE 1 NUMBER OF LABORATORIES WORKING ON SPECIFIC SUBJECTS

Particles	25
Gases	20
Meteorology	16
Collection, control by	10
Topography	9
Animals, effects on	8
Vegetation, effects on	4
Process changes, control by	2
Disposal, control by	2
Codes	1
Standards	1

Table 1 indicates the interest in various subjects shown by the replies of laboratories working on some aspect of the air-pollution problem. The specific subjects are described in detail in a later section.

The subject headings in the table are quite broad; a single heading such as "Particles" will include many ramifications. Nevertheless, it still indicates marked concentration. This is to be expected for in the early development of a field much effort is devoted to description and analysis. Later, when fundamentals are established, application can be made. In addition, such concentration reflects the field of interest of each institution, most of which are engaged in some form of physical or chemical research.

A study of the activity as provided in the detailed description discloses that many organizations are engaged in field surveys. Whether these surveys should be termed "research" is somewhat debatable except in the sense that such work, if published, is a scientific contribution, while also providing information on a local problem.

Field surveys usually include collection and analysis of air samples. Techniques for these purposes have not been standardized as yet, although ASTM Committee D-22 is making good progress in this connection. An opportunity for experimentation in methodology is presented.

Support for these research activities comes from many sources; governmental agencies on all levels, foundations, committees, associations of all types, industry, individuals, and, in some cases, the work is sustained by the research institution itself.

The list of publications originating in these research efforts is too lengthy to be included here. Reference to them will be made in a comprehensive bibliography on air pollution which is one of the committee

activities, and the reprints which were supplied will be added to the committee collection or donated to the Engineering Societies Library.

SUMMARY EVALUATION

What is the value, then, of this information? Probably for the first time it brings together a fairly complete compilation of the research being done on a subject of definite public and scientific interest. Even readers with a major interest in air pollution and who presumably have the best information available, will be surprised to learn of the relatively large number of organizations doing research in this field. Publication of this report is certain to bring to light other groups which may have been omitted. In addition it will be useful to those interested in sponsoring research on specific problems. While this report does not serve as an imprimatur, it can well serve as a guide. Persons or organizations seeking specific assistance can here find most, if not all, of the laboratories which are now active, or have been active in the recent past, on this particular problem. Finally, and this is the original reason for which the information has been collected, it may serve as a foundation for an effort by which some degree of co-ordination can be achieved.

CONDENSED STATEMENTS OF ACTIVITIES IN AIR POLLUTION AT LABORATORIES RESPONDING TO ASME QUESTIONNAIRE

ARGONNE NATIONAL LABORATORY (P. O. Box 299, Lemont, Ill.). Development of instrument for quantitative determination of small amounts of freon 12 in air; atmospheric dispersal patterns of effluents from stacks and in vicinity of buildings; basic structures in atmospheric turbulence and development of special equipment therefor.

ARMOUR RESEARCH FOUNDATION OF ILLINOIS INSTITUTE OF TECHNOLOGY (Technology Center, Chicago 16, Ill.). Development of sampling instrumentation and procedures; sampling investigations at specific plants; investigation and development of dust-removal equipment; instrumentation on particle-size measurement; research on properties of aerosols and travel of dust clouds; research on technical aspects of city zoning for atmospheric pollution; collection and analyses of settled dust; development of analytical methods for settled dust, gases, and fumes; and general study of air pollutants.

BATTELLE MEMORIAL INSTITUTE (505 King Avenue, Columbus 1, Ohio.). Comprehensive and definitive studies of problems arising out of combustion: Overfire jets for stationary boilers, locomotives, and for Scotch marine boilers; cinder collection for locomotives; reduction of fly-ash emission from spreader stokers; gravity reinjection of fly ash, low-draft-loss cinder and dust collectors. Urban and industrial air-pollution surveys; development of directional dustfall collector; metal fume-control system for electrometallurgical furnaces.

BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH, INC. (Yonkers 3, N. Y.). Effect of various gases and of fluorides on plants; identification of constituents in air pollution by use of plants as indicators; studies on fluorine, sulphur dioxide, chlorine, ammonia, hydrogen sulphide, and the intake of fluorides from the soil.

CALIFORNIA INSTITUTE OF TECHNOLOGY (Pasadena 4, Calif.). Analysis of Los Angeles smog for organic pollutants and their transformation products.

UNIVERSITY OF CALIFORNIA (Los Angeles 24, Calif.). Photochemical reactions of some constituents of contaminated air: (*a*) Sulphur dioxide in controlled laboratory experiments, with and without presence of oxygen and water vapor; and (*b*) nitrogen dioxide in presence of hydrocarbons and with and without oxygen.

UNIVERSITY OF CHICAGO (Chicago 37, Ill.). Behavior of natural clouds and possible effects of various aerosols; atmospheric dispersal of radioactive contaminants.

UNIVERSITY OF CINCINNATI (Kettering Laboratory, Eden Avenue, Cincinnati 19, Ohio). Establishment of character and source of air pollution; development of analytical methods; health effects on animals and man.

(Laboratory for Experimental Medicine.) Study of community health aspects of air pollution.

COLUMBIA UNIVERSITY (New York 27, N. Y.). Growth of aerosols, light-scattering visibility, particle size of aerosols; filtration and removal of fine aerosols, detection and removal of aerosols.

UNIVERSITY OF FLORIDA (Gainesville, Fla.). Air-pollution surveys: Sampling, analysis, meteorology, effect of air-borne gaseous pollutants on health, and on truck crops and commercial flower crops; determination of concentration of gaseous fluorine and sulphur compounds in atmosphere, to determine effect of varying meteorological conditions on dispersion of air-borne pollutants, and to locate sources.

GEORGIA INSTITUTE OF TECHNOLOGY (Atlanta, Ga.). Systematic study of effects which accelerate aerosol aggregation in suspension and methods of control.

HARVARD UNIVERSITY (55 Shattuck Street, Boston 15, Mass.). Investigation of specifications and ratings of commercial air cleaners; performance of air- and gas-cleaning devices for aerosols; and basic research on instrumentation for testing equipment.

UNIVERSITY OF ILLINOIS (Urbana, Ill.). Studies on combustion (J. R. Fellows); fundamental understanding of physical properties of aerosols (W. E. Ranz); development of processes for treatment of waste gases; causes of smog in Los Angeles and other cities; fundamental aspects of physics and chemistry of air pollution and of methods for removing solids at source (H. F. Johnstone).

UNIVERSITY OF INDIANA (Bloomington, Ind.). Fundamental properties of aerosols; instrumental methods of measuring mass concentrations and particulate concentrations in aerosols; and procedures for testing smoke filters.

INDUSTRIAL HYGIENE FOUNDATION (Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa.). Development of outdoor ground-level sampling instruments at low cost for determination of dustfall, smoke (blackening potential), sulphur dioxide and hydrogen sulphide; problems on sampling of particulate matter in stack gases; studies on kinetics of particulate matter, especially in stack gases, aimed at development of fundamental information pertinent to performance of dust collectors; techniques for examination of solids comprising air pollution of a city; and studies on chemistry of sulphur-dioxide oxidation.

STATE UNIVERSITY OF IOWA (Iowa City, Iowa). Scale-model investigation of fluid motion.

THE JOHNS HOPKINS UNIVERSITY (615 Wolfe Street, Baltimore 5, Md.). Chronic exposures to air pollutants and acute infections (Baetjer, A. M.); performance of institutional incinerators and disposal of radioactive wastes (Wolman, Abel).

UNIVERSITY OF LOUISVILLE INSTITUTE OF INDUSTRIAL RESEARCH (Third and Eastern Parkway, Louisville, Ky.). Urban air-pollution surveys.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (Round Hill Field Station, South Dartmouth, Mass.). Field studies of atmospheric turbulence and theory of diffusion; photographic studies of diffusion of smoke; and study of the fluctuations which characterize turbulent flow.

UNIVERSITY OF MICHIGAN (Ann Arbor, Mich.). Analysis of aerosols and suspensions; filtering and scrubbing mechanisms, and absorption methods of control of air pollutants.

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY (Campus Station, Socorro, N. Mex.). Analysis of air-borne particles; study of diffusion and mixing; and meteorological role of particulate matter.

NEW YORK UNIVERSITY (University Heights, New York 53, N. Y.). Development of equipment and techniques for wind-tunnel atmospheric-pollution experiments including effect of vertical temperature gradient and other factors affecting turbulence; laboratory studies of accuracy of certain measuring instruments, such as deposit gages, smoke filters, sulphur dioxide and thermal-radiation-measuring equipment; emphasis on wind-tunnel scale-model experimentation; analysis of meteorological data for correlating wind-tunnel characteristics with full scale.

OHIO STATE UNIVERSITY (Columbus 10, Ohio). Deposition of aerosols: Mechanism of deposition and performance characteristics of fibrous and granular filters; fundamental hydrodynamics of aerosol deposition; performance characteristics of cyclone dust collectors; generation and growth of aerosols; entrainment separation; economics of air filtration; and particle-size measurement.

ONTARIO RESEARCH FOUNDATION (43 Queen's Park, Toronto 5, Ontario). Measurements of dustfall, atmospheric dust, gas and vapor concentrations; meteorological studies; and determination of "corrosion potential."

PENNSYLVANIA STATE COLLEGE (State College, Pa.). Study of size spectrum of turbulence bearing on dispersal of air pollution; of effect of certain aerosols on spontaneous freezing point of small supercooled water drops; and effect of electrostatic charges of artificial and natural aerosols on properties of potential fogs; air pollution caused by mine-refuse fires (burning gob piles); evaluation of instruments for air-pollution study.

PITTSBURGH TESTING LABORATORY (1330 Locust Street, Pittsburgh 19, Pa.). Air-pollution surveys; techniques of stack sampling; examination of dustfall for source correlation; and sulphur-dioxide and hydrogen-sulphide determinations.

PRINCETON UNIVERSITY (Princeton, N. J.). Indirect research—effect of loss of sunlight on human health.

RUTGERS UNIVERSITY (New Brunswick, N. J.). Determination of urban particulate air pollutants.

STANFORD RESEARCH INSTITUTE (Stanford, Calif.). Construction, testing and calibration of automatic gas analyzer for Los Angeles smog; analysis of soil, vegetation, and animal tissues in connection with fluoride effluent from alumina-reduction plant; meteorological studies; investigation into occurrence and nature of ice fogs in Alaska; removal of sulphur compounds from stack gases in petroleum-refinery operations; testing of new gas-cleaning device; and major study of Los Angeles smog problem, especially on eye irritants and reduced visibility.

UNIVERSITY OF TENNESSEE (Knoxville, Tenn.). Fluoride-effluent analysis to ascertain channel through which fluorine enters plant and livestock (examinations of rain, pond, and river waters, and atmosphere through large-volume collections and exposures of Spanish moss).

UNIVERSITY OF TEXAS (Box F, University Station, Austin, Texas). Basic research on structure of atmospheric turbulence; and on radiometeorology.

UNIVERSITY OF TORONTO (Toronto 5, Canada). Urban air-pollution survey to form basis for smoke-abatement ordinance.

UNITED STATES ATOMIC ENERGY COMMISSION (P. O. Box 30, Ansonia Station, New York 23, N. Y.). Instrument development; field studies on relationship of ground-level concentrations at various distances from stacks to rate of emission, stack height, and meteorological variables; berylliosis; meteorological techniques; studies on radioactive dust from nuclear detonations.

STATE COLLEGE OF WASHINGTON (Pullman, Wash.). General area air-pollution surveys of damage to ponderosa pine; concentrations of fluorides, chlorine, sulphur dioxide, and particulate matter with varying meteorological conditions; observation of fluorine-sensitive vegetation and analysis of selected plants for fluorine content; controlled fumigations with hydrogen fluoride to determine typical damage patterns, relative susceptibility, and possible effect on terminal growth; cattle fluorosis; daily rate of industrial effluents; fluoride pickup through root systems of pasture grasses; development of automatic fluoride analyzer, chlorine indicator, recorders for atmospheric radioactivity, and spectrographic analytical method for fluoride content of pine needles.

UNIVERSITY OF WASHINGTON (Seattle, Wash.). To increase basic understanding of turbulent diffusion by photographic study of small-scale turbulence, cold layer near ground, and eddy conductivity.

WASHINGTON UNIVERSITY (St. Louis 5, Mo.). Development and design of "filter scrubber" dust collectors; development of low-cost collectors to remove small particles (down to submicron size) from fluid streams, continuously and with recovery of product.

UNIVERSITY OF WISCONSIN (Madison, Wis.). Fluorine toxicosis; toxic levels for dairy cattle.

Metal-Clad Laminates Used in Printed Circuitry

(*Continued from page 711*)

The most obvious method is simply to punch or drill holes through the conductor and the laminate, inserting leads of standard components into the holes, and soldering the leads to the conductors. Complicated circuitry is normally laid out on both sides of the piece to provide for crossovers. Connections between conductors on opposite sides may be made by component leads, tinned eyelets, rivets, pins, or simply short lengths of wire. Using the proper laminate, components can be unsoldered and resoldered several times before foil shows a tendency to lift from the base.

Dip soldering has been proved quite practical as an assembly technique for smaller units. With all of the circuitry placed on one side of the dielectric, holes about 0.040 to 0.045 in. in diameter are punched or drilled to take the leads of resistors, capacitors, subminiature tubes, and so on. All of the components are placed in position on the opposite side of the piece from the etched pattern, with their tinned leads inserted through the holes. Usually the conductors are fluxed prior to this operation with a noncorrosive resin-type flux. All the necessary connections are then made between the components and the conductors by a single short dip in a molten solder bath. After dipping, excess lengths of the protruding leads are trimmed off.

ECONOMY IN PRODUCTION

Printed circuits are practical principally because of their simplicity and uniformity. They are particularly adaptable to very complex commutators and switching networks where subminiaturization is required.

The great savings are in assembly labor, inspection time, and overhead. Assembly labor obviously is reduced by the automatic or semiautomatic systems. Inspection time is cut because of the excellent reproducibility of printed circuitry and its comparative simplicity. Overhead is lowered because many more units may be produced in a given amount of factory space.

APPLICATIONS

The future of printed circuitry, in general, is enormous. Developments to date have barely scratched the surface of possibilities. Their uniformity, ruggedness, and opportunity for use as sub-assembly plug-in replacement offers additional advantages in the maintenance of equipment in which they are used. Applications of the prefabricated circuits encompass a very large field in low-power apparatus including radio, television, hearing aids, automatic signals, and other electronic devices.

PANEL EXTRUSIONS *in* AIRCRAFT STRUCTURES

By HOWARD KASTAN

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THE extrusion process, probably more than any other metal-forming method, has provided the aircraft designer's imagination its greatest freedom. The tremendous variety of shapes extruded thus far attest to this fact. Although some of these shapes would insult even the most crude aesthetic sense, their very existence is a tribute to the flexibility and possibilities of the process.

The rapid expansion in the use of extrusions by the designer has been paced by the metal suppliers' progress in producing, from higher-strength alloys, increasingly complex shapes with successively thinner sections and improved tolerances. The result of this program, together with progress in integrally stiffened panel-structure design, introduces new areas for the use of extrusions. This is but one of many current extrusion-design opportunities. Others, such as the application of large massive sections, stepped extrusions, tapered extrusions, and impact extrusions offer equally interesting challenges to the designer. For brevity and clarity this paper will be limited to consideration of certain panel-type primary structures only.

PHILOSOPHY OF DESIGN

The philosophy adopted by the designer in his approach to a problem generally dictates the type of solution reached. Engineering, using science as its lathe in the competitive production of useful articles, has evolved a fundamental philosophy of making products "cheaper and more efficient." It is the responsibility of the engineering designer to examine all of his creations for conformity with this philosophy. This is particularly true of the aircraft structural designer who is dealing with an extremely expensive machine which is marketed largely on the basis of its functional efficiency.

The continuing program of searching for designs which reduce fabrication, assembly, repair, and maintenance costs, and which promote standardization of parts, constitutes the engineer's subscription to the first part of this philosophy. The continual striving for less weight and higher operating stresses without sacrificing durability and reliability exemplifies the aircraft designer's recognition of the second part. Unfortunately, the total philosophy is often applied to the generalities of design and overlooked in the particulars.

EVOLUTION OF AIRCRAFT STRUCTURAL DESIGNS

The all-metal airplane is synonymous with monocoque and semimonocoque structures. Except in the case of highly loaded, high-density structures, the pure monocoque form is relatively inefficient. For the loadings and structural densities of major components of medium and large-size aircraft, semimonocoque structure has proved most efficient. It is in the design of the latter-type structure that a steady evolution has occurred. The development of extrusions has contributed significantly to this evolution; the improvements in efficiency achieved by the use of extrusions in primary structure are notable.

Such improvements have been most evident in panel-type structures loaded primarily in compression, such as the surfaces of wing and empennage box beams. Here, in comparison with bent-up and built-up sheet-metal stiffeners, extrusions have given the designer the opportunity to create individual stiffening members with optimum geometry and distribution of material. Thus column and crippling allowable stresses have increased so that higher operating compression stresses have been achieved, resulting in lighter, more efficient structures.

The cost picture has not been affected materially when compared to sheet-metal-stiffener construction because:

1 Reduced fabrication costs for the extruded stiffeners have generally offset the higher cost of raw material.

2 Stiffener spacing on stiffened sheet panels has not been changed so that assembly cost, i.e., price of attaching the sheet to the stiffeners, has remained the same as for bent-up sheet-metal stiffeners. Reductions in cost actually have been obtained by using extrusions in place of built-up sheet-metal stiffeners.

At this stage of the evolution two conclusions may be derived:

1 The use of more expensive raw material does not necessarily result in increased final costs.

2 Because of cost considerations improvements in structural panel efficiency have been obtained by development of the stiffening elements only. The skin material has been left to buckle out of action and operate inefficiently at a low average stress because of the relatively large stiffener spacing. In addition, the skin thickness has not been tailored to the varying loads as efficiently as the stiffeners so that high prices in weight and money are being paid to provide splices for stepped changes in skin thickness.

According to expectations, attention has been diverted to improving the sheet element of the stiffened panel. The designer, much to the production-man's consternation, started stepping and tapering and lengthening every structural element within his reach. Out of this happy chaos came three major approaches to the problem of increasing sheet efficiency, Fig. 1:

1 Rolled tapered sheet with stiffeners attached by riveting as before.

2 Machined tailored-thickness sheet with riveted stiffeners.

3 Tailored integrally stiffened sheet with stiffeners and skin made in one piece—no attaching rivets required.

It is reasonable at this time to state that, after considerable indulgence in what is known as objective analysis, the author has become convinced of the merits of integrally stiffened skin construction. All the discussion henceforth may be considered appropriately prejudiced.

The reasons for this conviction, the anticipated role of extrusions, and proposed avenues of design and production development are reviewed in the following sections.

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Comparison of Methods for Improving Structural Panel Efficiency. All three of the foregoing methods have one advantage in common. They minimize the number of transverse skin splices in longitudinally stiffened panels. This feature, accomplished at the expense of increased raw material or fabrication costs, pays for itself in reduced weight, reduced assembly costs, and generally improved reliability of the finished structure. It

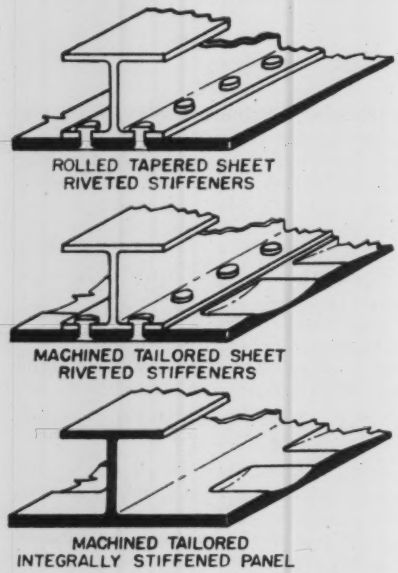

FIG. 1 TYPES OF IMPROVED EFFICIENCY SKINS FOR STRUCTURAL PANELS

appears to be the only advantage offered by rolled tapered sheet and represents probably the minimum efficiency increase obtainable over constant-thickness-sheet skins. Even in this respect the rolled tapered sheet does not afford as high a degree of improvement as the other methods.

The ability to suit the sheet thickness precisely to the load at any point in a panel provides a definite advantage in improving efficiency for machined tailored skins. The increased fabrication costs attendant upon machining may not be as large as expected from generalized analyses. The inevitable local problems occurring in long stiffened panels, such as cutouts, transverse former or rib attachments, service joints and doors, and mounting provisions for functional equipment always require local reinforcements of the skin. For flat or tapered rolled-sheet skins, reinforcements are provided in the form of riveted-skin doublers which add to fabrication, assembly, and maintenance costs, and to weight and sealing difficulties in integral fuel-tank applications. For machined tailored skins the reinforcing material is machined integrally in the skin during the general tailoring operation.

The use of machined tailored skins provides more efficient tension panels as well as compression panels. Here the local particulars of design assume great importance. The critical net sections in tension created by any riveted or bolted attachments, such as occur at joints, ribs, and doors, may be eliminated easily and lightly by local, integral, thickened pads machined on the skin to compensate for the loss in area resulting from attachment holes. In rolled-sheet skins there is no efficient means of compensating for local net sections. Consequently, large spans of a tension panel may be designed for relatively low operating stresses with resultant increase in weight. Experience to date indicates that, for highly loaded tension surface panels, machined skins may provide a 5 to 15 per cent weight saving over rolled-sheet skins. As operating tension stresses increase and design for fatigue strength warrants greater consideration, this feature of machined skins gains increasingly greater significance.

Returning to compression panel structure, a comparison may be made between machined tailored sheet with riveted-on stiffeners and integrally stiffened skin. This is done on the basis of the one remaining item which may be exploited for increasing efficiency: elimination of skin-buckling with maintenance of high stress level, i.e., increasing gross area compression stress.

The prevention of skin-buckling is accomplished by supporting the skin at sufficiently close intervals with stiffening elements. The stiffener spacing required is generally too close for economical application of riveted-on stiffeners. On the other hand, no fastening operation is involved in applying the stiffeners to integrally stiffened skin. Thus the design for 100 per cent effective area with this type of construction is uninhibited by assembly-cost considerations.

Since, in conventional practice with riveted-on stiffener construction, approximately 10 to 20 per cent of the gross area of a compression panel is inactive at design stress because of skin-buckling; the prevention of skin-buckling in such a panel should result in a 10 to 20 per cent saving in weight if peak stresses can be maintained.

This is being accomplished currently by the use of integrally stiffened skin panels on wing box-beam surfaces on the Lockheed Super-Constellation and C-130 airplanes.

In summary, analysis of the items affecting structural panel efficiency indicates the following: (*a*) Machined, tailored-thickness, integrally stiffened skin offers the most promising means of achieving highest efficiency in compression panels; (*b*) machined tailored thickness skin with riveted-on or integral stiffeners offers the most promising means of achieving highest efficiency in tension panels. In the foregoing analysis, efficiency has been given foremost consideration and cost largely ignored.

In the following section the cost aspects are reviewed and the prospect of satisfying the total "cheaper and more efficient" philosophy by the use of extrusions in integrally stiffened panels is investigated.

Costs and Extrusions in Integrally Stiffened Panels. Up to this time major integrally stiffened panels used in aircraft structure have been machined from thick-plate stock. In so doing only 5 to 10 per cent of the original raw material appears in the final product; the remaining 90 to 95 per cent of the stock is converted to chips which may be reclaimed as high-alloy scrap. This results in both high material costs and relatively high fabrication costs. Nevertheless, the total tangible costs in production of this type of structure, even with the present limited experience and inadequate tools, are only slightly higher than for equivalent conventional structure. The unevaluated intangibles, such as reduction in weight, reduction in engineering design and drafting time, and reduction in factory costs for paper work, handling, and stocking resulting from the extremely small number of parts in integrally stiffened structure, actually may transfer the total cost advantage to the integrally stiffened type.

By machining panels from extruded sections which roughly approximate the desired finished shape, considerable raw material and machine time could be saved. Although the price per pound for such extrusions would be much greater than for plate stock, it is anticipated that the use of extrusions would save approximately 50 to 70 per cent of the material being converted to chips in machining integrally stiffened panels from thick-plate stock. This saving would be reflected in large measure in fabrication costs. A study of production costs of two integrally stiffened panels on the lower surface of the Super-Constellation inner wing indicates that, if extruded stock were substituted for the currently used thick-plate stock, material

costs would be approximately equal and fabrication costs would be reduced by about 30 per cent. The total cost of material and fabrication operations for the extruded panels would be approximately 83 per cent of that for the thick-plate stock to produce identical parts. Equally important is the fact that in war-emergency conditions, the poor utilization of critical materials inherent in machining from thick plate could hardly be justified.

These are the more obvious economies of extruded panels. Additional economies, in comparison with thick-plate stock, are as follows:

1 Reduction in amount of substructure (transverse ribs and formers) required for supporting long panels because better column sections would be obtainable in extrusions.

2 Lower handling costs for raw material because of lighter weight of stock.

3 More compact storage of raw materials because of ability to nest extruded panels with each other.

4 Less setup time for machining because reduced stiffness of stock permits clamping of material to machine more easily.

5 Use of wider and/or longer panels than may be obtained in plate stock, because of billet-size limitations, would reduce assembly costs further by elimination of splices.

Perhaps of greater importance to cost than any of the items just mentioned is a unique possibility of extruded, machined, integrally stiffened panels which may be exploited by a co-ordinated development program. This is the possibility of standardization of extruded panel sections and extension of this standardization to joints and substructure spacing and attachment. Means of attaining such a goal will be discussed later. The effects of standardization on costs are sufficiently well known in technical fields to obviate the need for classification and explanation here. It is only necessary to observe the variety of designs in different airplanes for structural panels with the same loading requirements to understand the immediate economies of standardization. The real basis of low-cost mass production in the American economy is standardization. Why not apply this principle more fully to aircraft structures?

The role of extrusions should be important in the eventual obtainment of highly efficient structural panels inexpensively fabricated from basic standardized panel cross sections.

PROPOSALS FOR DEVELOPMENT

Co-ordinated development programs by the metal producers, the machine-tool industry, and the aircraft manufacturers are necessary to achieve the advances in efficiency and economy discussed in the foregoing.

The metal producers are required to develop means of producing and heat-treating integrally stiffened extruded panels from high-strength alloys which are wide (estimated up to approximately 10 ft), long (estimated up to approximately 90 ft), reasonably flat, straight, and which have thin sections, good surface finish, and close tolerances. The limiting size, flatness, straightness, and tolerance requirements should be determined jointly by the metal suppliers, the machine-tool producers, and the aircraft manufacturers. The configuration of the panels and the thicknesses of the various elements in the raw extrusions should be determined in co-operation with the aircraft industry.

The machine-tool manufacturers should be concerned with the development of machines that will handle the size and type panels noted previously and which will profile-cut both longitudinally and transversely to final thickness tolerances in the order of ± 0.002 in. In addition, rapid skin-thickness-measuring equipment for inspection purposes might be made an integral part of the machine so that overthickness conditions could be detected and corrected before the panel is removed from the machine.

The aircraft industry should consider engaging in a program for the development of a standard basic panel cross section which could be adapted, by minimum machining, to satisfy efficiently a reasonable range of loading conditions. Successful development of such a section should be followed by development of standard joints and attachments therefor. A quantitative evaluation of this design problem follows.

Formulation of the Design Problem. The formulation of the problem of designing a standard extruded panel cross section for efficient transmission of compression loads, such as in a wing or empennage box-beam surface, is based on the assumptions:

1 The panel is to be made from extruded 75S-T6 aluminum alloy.

2 Cross-sectional area of the panel is to be made 100 per cent effective in resisting compression at any point in the span.

3 The interaction of shear and bending loads with the compression loads on the panel is accounted for adequately by using a compression-stress ratio (ratio of design stress to allowable stress) of 0.85.

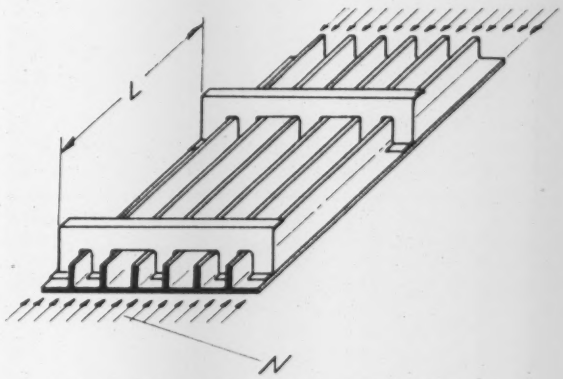

FIG. 2 LOADING OF STIFFENED COMPRESSION PANEL

Following are the symbols used in the development of the problem, Fig. 2:

N = compression load per in. of width of panel, lb per in.
F = allowable compression stress on gross cross-sectional area, psi
f = design compression stress on gross cross-sectional area, psi
E_t = tangent modulus of elasticity corresponding to f, psi
R_c = ratio of design compression stress to allowable compression stress = f/F, assumed to have a constant value of 0.85
c = column end fixity coefficient at panel-support points, assumed to have a constant value of 1.50
L = distance between panel supports; i.e., rib or former spacing, in.
ρ = radius of gyration of panel cross section, in.
t_e = thickness of flat plate which would have same gross area as panel cross section, i.e., panel cross-sectional area per in. of panel width, sq in. per in.

The first requirement is to establish a reasonable loading range within which a design of this type is required. The upper limit may be defined by the compressive yield stress of the 75S-T6 material, and the idea that any section requiring more area than a $^3/_8$-in-thick plate would be designed better as a flat-plate panel without stiffening. Thus

$$N_{max} = F_{yield}\, t_{e_{max}}\, R_c$$

$$N_{max} = 74{,}000 \times 0.375 \times 0.85 = 23{,}600 \text{ lb per in.}$$

The lower limit is established by experience which indicates that at sections just satisfying practical minimum-gage and stiffening requirements for a box beam ($t_e = 0.045$ approx) it is extremely difficult to achieve allowable gross-area compression stresses greater than 15,000 psi approx. Thus

$$N_{min} = 15{,}000 \times 0.045 \times 0.85 = 575 \text{ lb per in.}$$

The variation of working stress f, with loading intensity N, between the limits obtained in the foregoing is determined from design studies and actual designs of nonbuckling surfaces made for three Lockheed airplane wing box beams—the Constellation, Constitution, and C-130. Distance between ribs or formers L, is also based on this experience. These values of f and L may be considered minimums for efficient design. Any increase in these values would represent improvement in efficiency and would be most welcome.

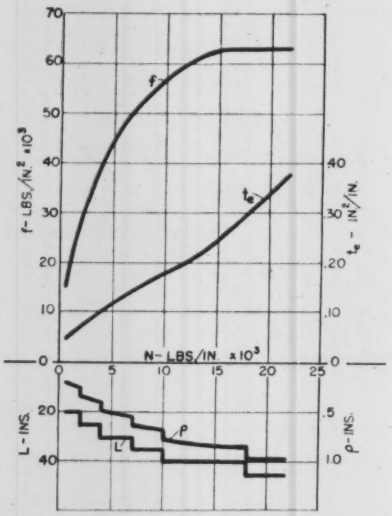

FIG. 3 SUMMARY OF THE DESIGN PROBLEM

The design requirements thus obtained are summarized in Fig. 3 where

$$f = R_c F \qquad t_e = N/f$$

$$\rho = \frac{L}{\pi \sqrt{c}} \times \sqrt{\frac{f}{E_t R_c}}$$

The first part of the problem then is to develop a single basic extrusion cross section from which sections satisfying the conditions in Fig. 3 may be obtained with minimum machining. The basic extrusion also should allow sufficient material for local reinforcement and should be of such a shape as to facilitate attachment of substructure and installation of efficient service joints. A further requirement, for surfaces employed as boundaries for integral fuel tanks, is to permit substructure attachment without fastening through the skin.

The second part of the problem is to develop standard joint designs, substructure attachments, and local reinforcements at various points in the loading range.

No attempt at solution of the problem is made here. Rather, it is hoped that this outline of the basic problem will stimulate co-operative effort throughout the industry to arrive at true standardization.

CONCLUSIONS

Extrusions will continue to play an increasingly important part in aircraft structures. The various new types of extrusions now being made available, such as massive sections, stepped sections, tapered sections, impact extrusions, and panel sections, offer interesting challenges to the structural designer.

With particular reference to panel-type structures, the extrusion process offers the possibility of providing a standard basic section from which the aircraft manufacturer may produce inexpensive highly efficient structural surfaces for box beams. This possibility may be exploited by a co-ordinated development program involving the metal producers, machine-tool manufacturers, and the aircraft industry.

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Light-Alloy Forging—Design and Production Problems

(*Continued from page 697*)

sive loading of the part at the tool tip due to insufficient support.

The necessity of minimizing residual stresses caused by heat-treatment is recognized by the author's company and much thought has been given, and will continue to be given to this matter. Investigations which we have conducted have shown that the proper sequence of machining operations is a great aid in equalizing the relieval of residual stresses. Compressive residual stresses, generally located at the surface of a forging, are balanced by tensile stresses in the interior part of the forging. Removal of the compressive stresses by alternate machining on both sides of a forging will assist greatly in holding distortion to a minimum. It may well be that when control is obtained over unexpected changes during machining, the aircraft companies may not demand as many close-toleranced, thin-webbed forgings as they now do. The machine shop may not object so much to extensive machining on a forging if the forging would remain stable during the machining operations.

CONCLUSION

It should be emphasized that it is vitally important in this heavy forging-press program for aircraft designers and forging producers to co-operate as the only means by which the objectives of the program may be achieved or by which its enormous cost can be justified. These objectives cannot be reached in a short space of time but will require sustained efforts over a long period. The progress made during the past 10 or 15 years in the light-alloy forging industry has been a key factor in the development of the American aircraft standards as we know them today. The promise for the future is even greater, and it is a promise which must be realized.

Developing Engineers Into Executives

By ROBERT F. PEARSE

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INTRODUCTION

ALL too often, we hear the statement that engineers make poor executives. Although all the aptitudes that the typical engineer tends to possess do not lend themselves perfectly to the requirements for modern industrial executives, the fact remains that engineers can and do make good executives. One recent and detailed evaluation of engineers indicated that in this particular group, about one out of three men warranted intensive executive development training (1).[1]

With American industry today getting more and more technical in nature, it is obvious that an engineering background, although not a requisite for a top-management man, is an extremely valuable asset.

Currently there is intense interest by industrial managements in appraising objectively the capacity and capabilities of the various executives who constitute their key personnel group. Such managements have found that poor executive decisions cost money. When an executive fumbles in the basic task of being an executive—that of getting results through others—costs, confusion, and tempers tend to rise simultaneously to new heights.

Whenever an executive is given an assignment that is incompatible with his personality pattern, he tends to become vaguely unhappy, discontented, and functions below par. As a result these men, who have ability but feel blocked or malassigned, tend to leave for other companies where job offerings seem more promising.

Psychological testing techniques, particularly those of the projective-personality variety, have and are giving good results in revealing total personality patterns which help to fit engineers into management positions where they can put their broad technical backgrounds to the greatest use.

TYPICAL PERSONALITY TRAITS OF ENGINEERS

Studies to date indicate that, in general, engineers have had family backgrounds and child-training experiences that tend to be typical of the American "middle-class" subculture. Such training indoctrinates individuals with the value-attitude and belief systems of this particular segment of our society (2). The values stressed are those usually associated with hard work, initiative, self-reliance, thrift, neatness to the point of meticulousness, and the sincere belief that one proves his worth as a person through continuously successful achievement (3).

Out of such middle-class child-training experiences come individuals whose personalities find compatible vocational outlets in the skilled trades: teaching, banking, law, business management, accounting, dentistry, medicine, and related work.

Insistence on Always Being "Right." One of the characteristics that engineers as a group tend to exhibit is an insistence on rigorously logical thinking and a determination always to find the right (i.e., factually correct) answer to any problem with which they are confronted. Engineers may become internally disturbed and even anxious when placed in situations in which it is difficult or impossible to function on such a basis. While such rigorous thinking is the essence of successful mechanical functioning, it is often not possible in the vast area of human relations where emotion and judgments replace logic and fact. Yet, current studies of executive duties indicate that successful executives have to spend large amounts of their time on human-relations problems.

The deep insistence of engineers on being "right" at all times may arise from typical family situations in which parents (principally the father) insistently demand logical performance from the child. They reward and encourage behavior that is logically correct and discourage spontaneous impulsive tendencies that may seek expression. One way for the child to react to such a situation is to outdo the father by "being right" as often as possible. Through internalization of parental aims and standards, he comes to feel that he himself is "good" and "worthy" to the extent that his behavior reflects this concept.

While scientific accuracy is the backbone of our machine civilization, in applied engineering a compulsive insistence on always being "right" may be detrimental to the extent that production decisions often are a compromise because all required facts cannot be obtained and exhaustively analyzed. "Art East" is a case in point. In his early thirties, Art has been advanced rapidly to the position of assistant plant manager for a large company. By nature, Art is a deliberate methodical thinker who feels extremely uncomfortable unless he has all the facts at hand on which to base a decision. Like many engineers, his slide rule lies constantly on his desk throughout the day. It is a silent symbol of Art's belief in the immutable laws of mathematics on which he tries to base as many decisions as possible. But in the continual turmoil and change of everyday production requirements, Art always feels a little bit lost. Usually he is just a little unsure of himself because he is forced to move faster than his personality and training let him feel comfortable in moving.

At staff meetings, Art (despite his very superior IQ as measured by conventional tests of adult intelligence) is often bewildered at the pace of decision making. The more rapid thinkers and those satisfied to sketch out the general picture without overconcern for minute details, leave him behind. He can feel comfortable only when he has everything "nailed down." But the very nature of production in his dynamically changing industry is such that it is impossible for him ever to be completely sure of each tiny detail. Consequently, Art is chronically troubled and eventually this uncertainty which is so abhorrent to his inner self, is bound to take its toll to some extent.

Hostility Toward Authority Figures. Another characteristic generally common to engineers is a tendency toward varying degrees of hostility in relation to authority figures or bosses. This is often true of middle-class children who have been forced to conform to parental standards in weaning, toilet training, educational achievement, and vocational choice, without much voice in the matter anywhere along the line. The consequence of such hostility is that there will often be an inner resentment of all people in authority such that may interfere with smooth job relations or create a tendency to resist ideas emanating

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[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

from superiors simply because they come from authority figures.

In the proper amount, this resistance can create a healthy state of intellectual independence and individual initiative which makes for superior performance. But when overdone, it can turn into chronic resentment, "feet dragging," and just plain stubbornness. In the extreme form, it can cripple an otherwise brilliant engineering career.

The case of "Herb White" is one in which reactions to an extremely dominating father have had unfortunate negative effects. Herb again has very superior IQ as measured by adult intelligence tests. He was graduated well up in his engineering class about 20 years ago at a prominent university. Since then, Herb has been pretty much confined to a role of chief draftsman and detailer in the company he has worked for since graduation. Charlie West, one of his classmates, has risen to the position of president of this company and become a corporate officer during the same period. There was no favoritism shown Charlie; he rose because he could handle difficult assignments well. In a technical sense, he is no better an engineer than Herb. But he has a wealth of drive, an alert imagination, and a willingness to accept responsibility that is lacking in Herb.

Herb's father was a farmer. A strong-willed man, he directed his family with an iron hand. Herb's early attempts at self-assertiveness were beaten down, literally with a strong arm. Through childhood conditionings, Herb developed a tendency to feel both chronically hostile toward his father and at the same time submissively dependent upon him for suggestions and ideas. Herb feared to plunge ahead on his own because he was likely to be punished for such attempts. So he has gone along through the years confining himself to the more detailed phases of engineering, hesitant and fearful of stepping out and doing things on his own.

His boss, Charlie West, often has tried to give Herb assignments that would encourage him to develop and put to work his relatively high engineering potential. But each time, things didn't quite seem to work out. On occasion, Herb has asked to be returned to more detailed work in which he does not have to function independently or be responsible for important decision making. Now in his middle forties, Herb works sporadically until quitting time, then rushes home and tries to give outlet to his creative abilities in a variety of hobbies. Here he can work alone, unsupervised by a fatherlike boss. Yet, even here, with complete freedom to do what he wants, he seldom is as creative as we would expect for one of his intellectual "horsepower."

Since most of us have to work under relatively direct supervision in America's mass-production large-corporation industries, heavily negative reactions toward those in authority can be detrimental to executive development. While independent thinking is important, complex industrial decision making more and more tends toward the committee or joint problem-solving approach. Here we are forced to work with, for, and through others to get the best results. Few "Captains of Industry" are so capable and so free of supervision today that they actually function autonomously in making large-scale decisions. There is always an executive committee or a board of directors around to temper the individualism of even the "ruggedest" individual.

Avoidance of Close Interpersonal Relationships. Like many physical scientists (4) engineers often show a considerable independence of the need for close personal relationships. In past familial living, warm, positive, friendly relationships were apt to have been subordinated to a relatively cool, intellectual interaction between family members. Consequently, in adult living, warm or close relationships with other people may bother them. With remoteness toward people can go a difficulty in becoming interested in the subtleties of human behavior which is frequently illogical and heavily emotional in tone. Human relations and the understanding of human motivations tend to "come hard" for those who are somewhat remote from others.

It is just at this point where the current definition of an executive as one "who gets results through others" is apt to be difficult for the engineer. He may find difficulty in understanding, let alone practicing, the fine but trying art of leadership at the human-relations level. Like the military officer, he may lead by virtue of his title, position, and status without any particular perception of the emotional state of the person who receives orders and is expected to carry them out. Unfortunately, human beings with their internal conflicts, their emotions in place of logic, and their intensely personal reactions to situations are not as predictable in function as are machines.

Limited Effectiveness in Getting Results Through Others. Supervision of others and achieving results through their efforts may be one of the most difficult development points for engineers who aspire to top executive jobs. Since the engineer is usually right in a factual sense, he frequently becomes bewildered by the refusal of other people to think and act on logical grounds. We are all familiar with engineers who have become executives in title, position, status, and salary without ever really having become top-notch leaders of men. Similarly, many military commanders seem to get results more by virtue of an Act of Congress than through their own skill as democratic leaders.

Jim Green is such a man. He retired as president of an important segment of a major corporation after what seemed on the outside to be an unusually successful engineering-executive career. Jim "fell into" a key job some 25 years ago. This was long before formal executive appraisal and development programs had been installed in this country to any extent. In fact, Jim was the only man around who was remotely qualified to fill the vacancy when it came up.

Over the years he was promoted in the organization and retired with honors. But the men who worked for Jim knew how really limited he was as an executive. He lacked a broad or intuitive understanding of all the elements of his job as president. Yet he feared to admit or show any limitations in his knowledge. So he used the familiar tactic of focusing attention elsewhere by asking unpredictable questions and issuing spur-of-the-moment orders that frequently were conflicting and confusing. It was often said of him that the last person who talked to him really decided a policy, because Jim changed his mind after each conversation.

Some staff members refused to commit the company on any considerable issue without having Jim's initials on a memo, even though the decision was nominally their responsibility. They had learned through sad experience that he was quite apt to chide them next week for the very thing he had insisted they do—even over their objections—completely forgetting what he himself had ordered. Hence everything, even minor items, had to "bottleneck" through Jim because temperamentally he was incapable of delegating authority and responsibility. Only an extensive financial audit with an intimate knowledge of the man and his methods could really give this corporation an estimate as to just how many thousands of dollars it cost to call Jim an executive and keep him on the pay roll making poor decisions. Actual figures are largely buried in various operating accounts.

EXECUTIVE-DEVELOPMENT PROGRAMS

Many American corporations have elaborate programs to search out and train executives that are so sorely needed today (5). Few companies with such programs would go back to the old days in which too often incoherent, disorganized, and hap-

hazard methods of selecting and training executives were the rule.

One of the major drawbacks of formal executive-development programs has been the difficulty of objectively and accurately appraising candidates for intensive executive training. Unfortunately, in this complicated area of attempting to judge others honestly and adequately, personal biases get in the way of objective appraisal. These biases often function deviously and unconsciously. Rationalizations are "made up" to justify judgment about certain persons. If our biases cause us to overrate a poor man or underrate a good one, we make expensive decisions for our company when these erroneous judgments are translated into personnel policy. "Pooled judgments" or group appraisal of the subjective sort, too often reflect the overt or covert sentiments of the top man in the judging group. Most of us think twice before contradicting the judgment of a strong superior.

TECHNIQUES OF APPRAISAL AND MEASUREMENT

Pencil and Paper Tests. Early attempts to measure personal abilities largely involved the use of "pencil and paper" tests. Here the person tested was asked to supply the correct answers to test problems or to make discriminating judgments of various sorts. The numbers of successful trials or correct answers were manipulated statistically to provide a "score" or measure of the individual's relative performance. Norms were compiled, based on the statistical distribution of scores obtained by individuals on such tests.

Then attempts were made to predict probable job performance on the basis of test scores and test-score patterns. In jobs of manual, repetitive, and clerical nature, a considerable degree of success has been attained (6).

Selection and placement problems in the Armed Forces during the two world wars led to further study and refinements of predictive measures in military manpower situations (7). While individuals may differ, most people feel that a pretty fair job of classification was done, particularly in World War II. Particularly is this so in terms of the magnitude of the task and limitations of facilities available.

Further statistical refinements in such testing through factor-analysis techniques (8) have brought to light clusters of traits, abilities, and aptitudes which were being measured in different degrees by unco-ordinated and random tests. Recently, tests based upon the findings of factor analysis have been developed which aimed at measuring "pure" aptitudes or abilities.

Attempts to use conventional paper and pencil tests to predict executive-job performance were not always successful in the judgment of people who attempted to do such matching (9). Many executives with high test scores were considered to be relatively poor on their jobs. Sometimes the reverse was true. High-scoring people might have emotional difficulties which limited their effectiveness. In view of our knowledge of the powerful emotional conditioning effects of early child training and resultant adult behavior at the symbolic and emotional levels, this is not surprising (10).

Pencil and Paper Personality Tests. To get at the important area of emotional adjustment, many companies switched from straight aptitude testing to the consideration of personality factors by means of pencil and paper personality tests. Research findings indicate that intelligent people are often able to "outguess" such tests; that is, they have a pretty good idea of how their answers will be interpreted if they select a "yes" rather than a "no" response to some question attempting to get at emotional reactions.

For example, a man with a severe anxiety disturbance that required him to take a leave of absence for psychiatric treatment might come up with a profile on such a test that was out of line with the known facts on his emotional disturbance. He would get a pattern that was very high on "self-confidence," "dominance," "aggressiveness," and other desirable traits. This showed that he was able to outguess the test.

Projective Personality Tests. To avoid such outguessing and in an attempt at delving into deeper levels of personality, projective test techniques for evaluating personality have been tried out increasingly in industrial situations (11). One of the early post World War II publications on the dynamics of executive performance obtained from such techniques was reported on by Henry (12).

Clinical psychologists have long used projective techniques such as the Rorschach test (13), the Thematic Apperception test (14), and the Szondi test (15) to explore deeper levels of personality adjustment and consequent behavior. The application of these techniques to industrial-personnel problems, including executive appraisal and development, is a relatively recent event.

Psychometricians, schooled in the statistical treatment of "correct answer" tests have raised various objections to the scientific bases which underly such tests. Stephenson (16) in a penetrating article, has taken issue with some of their conclusions. As research findings continue to accumulate from industrial-personnel use of such techniques, a growing body of evidence indicates that they can be used successfully to appraise people in industry (9, 17, 18).

Executive appraisals using projective test interpretations of individual personality patterns have given both individuals and managements valuable insights into the reasons why people behave the way they do in top-level jobs. Such knowledge is crucial to executive appraisal and subsequent developmental training. Companies have done personnel research with projective techniques so as to derive useful answers to many perplexing problems of human behavior. The Glenn L. Martin Company recently has reported on its 5-year experience with one type of projective technique (17). This article includes the results of a crucial problem of engineering-executive selection.

An Engineer-Executive Case Study. Another study concerning the industrial-engineering staff of a Midwestern corporation was reported recently in preliminary form by this author (1). After rating members of the staff on eleven crucial traits, the chief industrial engineer ranked each individual in terms of the quality of such trait he thought the man possessed. The personnel director filled out a similar form on each man, working exclusively from the analysis of a projective personality technique. In most cases the personality analysis was made without the man ever having been seen. When evaluations were compared man by man and trait by trait between the chief engineer's judgment and the personality analyst's predictions, there was complete agreement (on a five-point scale ranking) in 45.7 per cent of over 600 separate and completely independent judgments. In another 41.8 per cent of the ratings there was a difference of only one scale step between the judges. The high correlation between the judgments indicates the precision with which predictions may be made from projective personality data in terms of industrial evaluations.

Validation Studies on Predictions From Projective Techniques. A detailed study was made recently as to the actual tenure and dollar volume of sales of salesmen in one organization (18). In this study it was found that had ratings based on projective personality test analyses been used to select salesmen—with no other selection device being used—the estimated total sales volume would have been increased 34 per cent or about a quarter of a million dollars a year in the company which undertook the study.

Current Research Activities on Occupational Success and Personality. The past few years have seen a great deal of work done in the

field of investigating the relationships between personality characteristics and occupational achievement. Among leading workers in this field are Drs. Eli Ginzburg and Donald Super of Columbia University; Richard E. Worthington, formerly of The University of Chicago; and Ann Roe. Dr. Roe has published a series of articles on the results of her research on the characteristics of eminent physical scientists, using projective techniques along with other instruments. Her forthcoming book, "Making of a Scientist," is scheduled for early publication.

In a recent article (4) she mentions that we presently cannot isolate qualities peculiar to a single occupational group since all occupational specialists are also people. As such, they have been exposed to common social and cultural experiences (2, 19), together with others in their social class groups. She indicates in this article the tendency of physical scientists to be immersed in creative work activities, and to forego close relationships with people.

Like her physical scientists, engineers in addition to being occupational specialists are also people. None of the statements tentatively offered in this paper will apply equally to all engineers, just as her findings do not apply equally to all of the eminent scientists which she has studied. Some of the characteristics that have been suggested to be typical of the engineer, naturally also will be found in other occupational groups. The present level of our knowledge concerning the relationship between occupational success and personality does not permit us to predict concerning occupational success with absolute precision. However, we do have a number of significant leads.

EXECUTIVE DEVELOPMENT SUGGESTIONS FOR ENGINEERS

What hints might the engineer take that would assist him in speeding his development as an executive? The growing technological complexity of industry impels engineers toward executive positions. This is because their "know how" is so intimately connected with American industrial production. Perhaps the things that engineers might do with the greatest personal benefit center around increasing understanding of their own personalities. They could become more consciously aware of the ways they typically tend to react in crucial situations. Particularly would this apply in situations involving people and emotions. Understanding of their own inner feelings and reactions might be one point. When their executive roles require them to "get results through others," they might think about why they may feel tempted to "blow their top" or react negatively to situations involving human foibles or frailties.

This sort of awareness might well temper instinctive tendencies to judge or criticize with the knowledge that there are available rough but effective techniques for working with and through other people. These techniques require tolerance, patience, and appreciation of emotional factors influencing other people's behavior. Above all, they might reflect on the early training situations in their own lives which cause them to cling to facts, logic, and things—as against having spontaneous, close, and warm relations with other people.

Particularly in production situations where it is often not possible to have all the facts, they might be aware of reasons for feeling "uneasy" or "insecure" when asked to tackle an assignment without having all details in order. This could be done without sacrificing the engineer's excellent qualities of insisting on accuracy to the highest degree possible and practicable. Nor need the fine quality of seeking a planned, orderly approach to all problems be subordinated.

Engineers also might think about any tendencies to react negatively to authority and authority figures or bosses, in terms of early-life experiences. They may find that instead of actually resenting treatment from an immediate supervisor, they are emotionally contending with the ghost of their father and are rebelling against the memory of his standards and requirements.

Also might be considered the trend toward joint decision-making, group planning, and mutilateral action. Here they will have to rely on others. Assistants may be less emotionally controlled and precise than the engineer himself. Dealing directly, punitively, and factually with such people's shortcomings may confuse, discourage, and alienate them. Tactful, considerate, and human relations, oriented leadership seems the only long-run approach to being an executive in a free and democratic society.

These suggestions are not intended as criticisms of engineers. It is recognized and appreciated that the engineer as a person has a relatively high level of emotional stability and adjustment. Without his contribution, our machine civilization simply couldn't function. Without him, none of us would be enjoying the standard of living that machines have given us. These suggestions are offered rather with the thought in mind that our evolving technology is impelling the engineer, whether he wants to or not, to go in the direction of having to assume an executive role in American industry.

When the slide rule on the engineer's desk is joined by the latest and most practical findings on human motivation and behavior, when the engineer can use both tools to solve executive problems as needed, then will both our machine civilization and the profession of engineering be mightily enhanced.

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BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. JAKLITSCH, JR., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Anniversary Bulletin

WITH its July, 1953, number the *Industrial Bulletin* of Arthur D. Little, Inc., Cambridge, Mass., reached its 300th issue. Since many of the excellent reports and articles which have appeared in the *Bulletin* have been quoted, abridged, or abstracted in "Briefing the Record," it seems appropriate to review some of the scientific and technological developments reported in the *Bulletin* since the first issue in January, 1927. To a large extent, the July issue notes, this period, particularly the latter portion of it, represents the first full harvest of organized corporate industrial research, which began slowly around 1900.

The extremes to which scientists have pushed their studies of matter exemplify some of these advances. In 1927 liquid air at —321 F was a powerful tool in low-temperature research; today liquid helium at —456 F, is common. On the other end of the scale, temperatures of around 4500 F were just being attained; now controlled chemical processes operate up to 8000 F and temperatures in the atomic bomb may reach 90,000,000 F. Present-day extremes of pressure, speed, size, and accuracy were unheard of two decades ago. The visible limits of outer space are now millions of light years away, thanks to the big telescopes and the latest techniques of astronomy, but our microcosm ranges down to the internal structure of the atomic nucleus. Man stands about in the middle of this scale of sizes; his view in either direction is acute, and increasing in clarity, the *Bulletin* states.

Not all the advances of pure science have been felt in the market place, but a growing number of the laboratory curiosities reported much earlier in the *Industrial Bulletin* have become full-fledged consumer products—or industries—in their own right. In 1929 a petrochemicals industry was forecast; in 1933 the shift from soaps to synthetic detergents. In 1927 the widespread use of synthetic rubber was a "possibility," and the electronics industry was an infant. Nylon first reached the consumer in 1938; penicillin was introduced in 1940. Since May, 1944, a hundred issues ago, atomic energy, radar, water-based paints, pipe lines for fuel transport, and many other new developments have staked out substantial claims in the then much-heralded brave new postwar world.

Atomic energy has emerged as the most important technological factor of the decade and perhaps of the age it has ushered in. Following its spectacular announcement in 1945, the *Bulletin* noted the outlook for its peacetime uses. Industrial applications of radioactive tracers, it was reported, would be "greatly expanded"; by late 1952 over 30,000 shipments to industrial and medical users had been reported. In 1945 it was said only that "atomic power.....is not yet really close." Since then, power has actually been generated from atomic fission, and the ultimate extension of fuel reserves through breeding has been announced.

The influence of technology on everyday life has become apparent, during the decade, in a great number of ways. In 1947 the light metals, aluminum and magnesium, began to appear in quantity in the form of window frames, auto license plates, garden furniture, skiis, and many other products. Then, in 1948, the *Bulletin* reported du Pont's interest in Terylene, now familiar as Dacron, one of the synthetic fibers which have so profoundly affected the textile market. Once the ball started rolling, it picked up momentum fast. Orlon was discussed in the *Bulletin* in late 1948, and Vicara and the acrylics, Acrilan and Dynel, in 1950.

In 1948, also, the transistor was reviewed as a possible competitor for electronic tubes. This device, representing a great step forward in the electronics art, is still short of complete practicality, but is almost here as an essential element of the "clerical revolution" forecast in 1949 to be accomplished by the large-scale computers. Navigational aide (1946), new printing techniques (1950), and the communication of information through microwaves (1951), all dependent upon recent advances in this field of technology, have helped to make the word "electronic" a close second to "atomic" as a characteristic of the age.

What of the future? Judging from the material presented in the *Bulletin* during 1952 and early 1953, the impact of technology in the next decade will be as great as that in the last. The chemistry of the steroid compounds, cortisone, ACTH, and the like, bids fair to become a dominant factor in medicine. Through improved fertilizing techniques, chemical modifica-

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

tion of the soil, and great advances in the science of nutrition, man is learning more about the care and feeding of his increasingly healthy and long-lived population. His ability to work effectively will be increased through the advancing technology of fuels and power, but his need to work will be reduced by relegating his more menial tasks to control mechanisms. If the emphasis continues primarily on production for peace, his greater leisure will be enriched by developments in plastics, sound reproduction, printing, housing, and gardening, which are just now reaching the consumer markets in quantity.

With man's physical environment improving through technology, those possessed of the spark of creativity continue to avail themselves of the widening basic knowledge of the physical universe, in its broad structures and its extremes, to surmount the many scientific Everests which remain. The *Bulletin* looks forward, in its next hundred issues, to reporting these conquests.

New Technical Journal

PUBLICATION of a magazine to present General Motors technical developments to educators and engineering-college students was announced recently by Paul Garrett, General Motors vice-president in charge of public-relations staff.

To be known as *GM Engineering Journal*, the new publication will appear bimonthly during the school year and once during the midsummer months. The first issue for June-July has been released.

The new project is being handled by the Educational Relations Section of Public Relations Department, headed by Kenneth A. Meade. Editor of the *GM Engineering Journal* is Arvid F. Jouppi.

Mr. Meade said the *Journal* is the outgrowth of many discussions between GM engineering officials and engineering-college educators during the past year.

Educators, he said, indicated such a magazine would be valuable for instructional use with engineering students. It will present up-to-date information about research, production, and product-engineering developments throughout GM divisions and various technical staffs.

It also will develop news items about GM engineering programs of interest not only to engineering educators and students but also to engineers within the GM organization.

At the same time, Mr. Meade declared, it will help give increased recognition to GM engineers and technicians for the technical developments they produce.

Contents will include signed articles by GM engineers in virtually every field of engineering—electrical, chemical, mechanical, and the like—as well as most of the scientific fields as applied to industry, research, and engineering developments.

The articles will be beamed toward engineering students at the junior, senior, and graduate levels. The material will be designed to assist college instructors and professors to supplement their classroom presentations with the latest data and information about the application of their particular course subjects.

Helicopters

SOME interesting design proposals for two simple high-speed jet-powered helicopters and two simple high-speed jet-powered compound aircraft have been advanced by I. B. Laskowitz, Mem. ASME, a consulting engineer of Brooklyn, N. Y.

According to Mr. Laskowitz, the designs embody the elements of the autogiro, the helicopter, and the fixed-wing plane in a simple manner by applying the exhaust from turbojet engines to a hollow-bladed rotor or diverting the exhaust gases partly or wholly, when desired, rearward to produce a direct forward thrust. In flight, the rotor is constantly in motion, acting as a helicopter rotor when power is applied to it or as an autogiro rotor when no power is applied to it, and the craft is propelled forward by the direct forward thrust of the jet.

The Model L15H, Fig. 1, a simple high-speed helicopter, is powered by a Boeing turbojet engine No. 500 of 175 lb thrust. The two-blade rotor has a diameter of 30 ft. The gross weight is 1500 lb, empty weight is 802 lb, and useful load is 698 lb. It will accommodate the pilot and one passenger and attain a maximum speed of 150 mph with a maximum range of 175 miles.

Fig. 2 shows a simple high-speed compound aircraft, the Model L15C. Powered by a Boeing turbojet engine No. 500 of 175 lb thrust, the two-blade rotor has a diameter of 30 ft. The fixed-wing span is 16 ft. The gross weight is 1500 lb, empty weight is 850 lb, and useful load is 650 lb. It will accommodate the pilot and one passenger and attain a maximum speed of 200 mph with a maximum range of 192.5 miles.

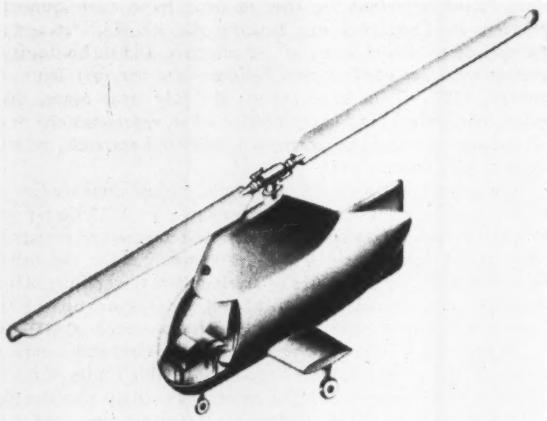

FIG. 1 MODEL L15H SIMPLE HIGH-SPEED JET-POWERED HELICOPTER

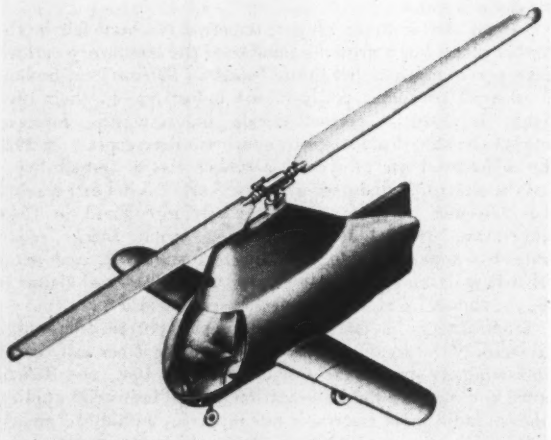

FIG. 2 MODEL L15C SIMPLE HIGH-SPEED JET-POWERED COMPOUND AIRCRAFT

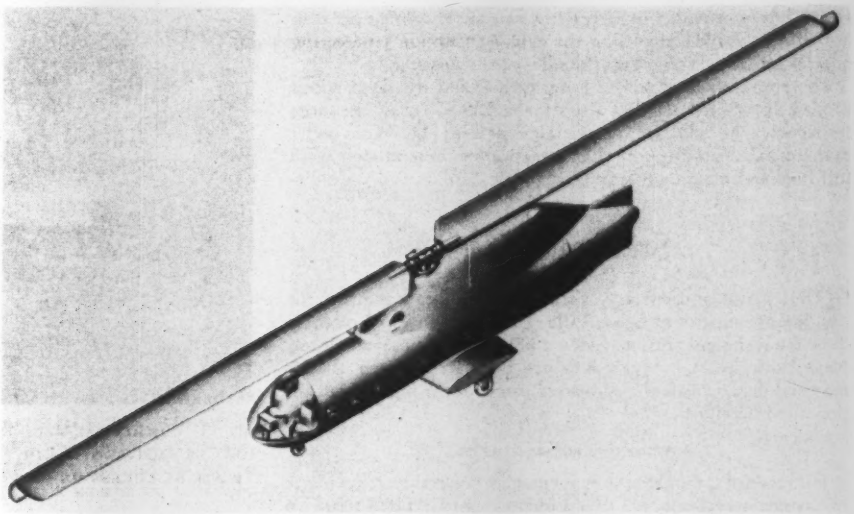

FIG. 3 MODEL L180H SIMPLE HIGH-SPEED TRANSPORT-TYPE JET-POWERED HELICOPTER

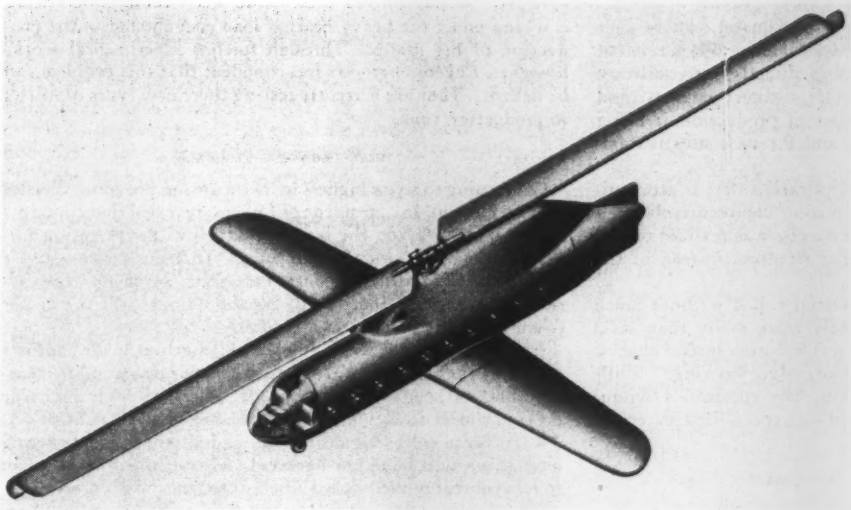

FIG. 4 MODEL L180C SIMPLE HIGH-SPEED TRANSPORT-TYPE JET-POWERED COMPOUND AIRCRAFT

Higher speed and range than the Model L15H are obtained for the additional cost of the fixed-wing.

The Model L180H, Fig. 3, a simple high-speed transport-type helicopter, is powered by two Westinghouse J-30 turbojets of 1360 lb thrust each. A two-blade 104-ft-diam rotor is provided. The gross weight is 18,000 lb, empty weight is 10,056 lb, and useful load is 7944 lb. It will accommodate the pilot, copilot, and 21 to 28 passengers, and attain a maximum speed of 200 mph with a maximum range of 207 miles for the 21-passenger and 133 miles for the 28-passenger machines. Single-engine operation of full load at reduced speed but with maximum ranges equal to that of twin-engine operation, is attainable.

A simple high-speed transport-type compound aircraft, the Model L180C, Fig. 4, is powered by two Westinghouse J-30 turbojets of 1360 lb thrust each. A two-blade 104-ft-diam rotor and a fixed wing having a span of 55 ft are provided. The gross weight is 18,000 lb, empty weight is 10,830 lb, and useful load is 7170 lb. It will accommodate the pilot, copilot, and 21 to 28 passengers and attain a maximum speed of 300 mph with a maximum range of 316 miles for the 21-passenger and 146 miles for the 28-passenger machines. Single-engine operation, of full load at reduced speed but with maximum ranges equal to that of twin-engine operation, is attainable. Higher speed and range than the Model L180H are obtained for the additional cost of the fixed-wing.

All four models feature manual or automatic control of collective pitch; jet-steering; optional direct forward thrust; retractable tricycle landing gear; pressure jet-driven rotor, hence no appreciable reaction torque; and optional use of afterburner.

The use of the fixed wing at additional cost for Model L15C Fig. 2, and Model L180C, Fig. 4, while increasing the empty weight and reducing the useful load, comes into play in cooperation with the direct forward thrust to relieve the load on the rotor and results in increased speed and range. All models are provided with a cyclic pitch (azimuth) stick and a collective pitch stick connected to a swashplate for control of the rotor blade pitch angle. Optional automatic control of collective pitch is also provided for all models. Directional control of

all models is provided by operating foot pedals which are connected to a valve controlling the exhaust through jet-steering nozzles located rearward on the sides of the fuselage.

The rotor blades may be hinged back and the fixed wings hinged up. While models L180H and L180C are of the large transport type and are twin-engine driven, Mr. Laskowitz pointed out that single-engine operation of these models with full load and maximum range is possible.

Steelmaking

THE many unusual and varied operations of the Lukens Steel Company of Coatesville, Pa., were unveiled recently during a technical press exhibition held at the Roosevelt Hotel, New York, N. Y. Space does not permit reviewing all the material made available; however, some of the high lights are presented herewith.

TITANIUM PLATES ROLLED

For example, G. Donald Spackman, vice-president in charge of operations, announced that Lukens recently rolled titanium slabs weighing about 1000 lb each and $2^1/_2$ in. thick, to $^5/_8$-in-gage plate on its 120-in. and 206-in. rolling mills.

He pointed out that titanium is approximately 40 per cent lighter than steel and that at present approximately 95 per cent of the production of this metal is going directly into military appliances such as airframes, aircraft turbojet engines, and ordnance. The remaining 5 per cent of production is being utilized for experimental purposes, and for such uses as food-processing vessels, and the like.

As an example of a commercial application that is economically feasible, despite the metal's present comparatively high price, a saving of 200 lb per engine nacelle was realized on the new Douglas DC-7 airliner by using titanium instead of the stainless steel originally specified.

Mr. Spackman said that the material rolled without much evidence of hardness, and apparently more easily than solid stainless steel. The rolled surface was free from surface checks, and the as-rolled edges were free of any edge-checking. While Lukens is not a titanium producer, the company's unique facilities permit conversion rolling of such specialized materials, he added.

HEAT-TREATING ROLLERS

It was also revealed that silicon-carbide heat-treating rollers capable of withstanding temperatures up to 2000 F are under development at Lukens to speed production of stainless and clad steels.

Heat-treating rollers designed to operate at temperatures up to 1500 F have been made of hard tough chrome-alloy steel. But radically increased temperatures of a new heat-treating process under development at Lukens have brought about extensive experimental work on this new type of silicon-carbide roller.

The temperature at which clad and stainless steels are heat-treated is 1950 F—unusually high for this type of furnace. The different rates of expansion cause trouble in alloy and carbon-steel rollers. When chrome rollers—which are completely satisfactory at temperatures up to 1500 F—were tried at higher temperatures, rollers broke, bearings exploded, and furnaces often had to be cooled for 32 to 40 hours before repairs could be made. It was also found that stainless-steel plates developed metallic "pickup" from the rollers during heat-treating which pitted the plates and made them unfit for use.

After years of investigation and experimental work, silicon-carbide rollers have been developed that will carry stainless steel at up to 2000 F with no pickup or other imperfections. However, it has proved difficult to keep these rollers from cracking under the heavy bearing load encountered in the production of big plates. Through further experimental work, however, Lukens engineers feel confident that this problem can be licked. They are currently testing three new types of rollers in production runs.

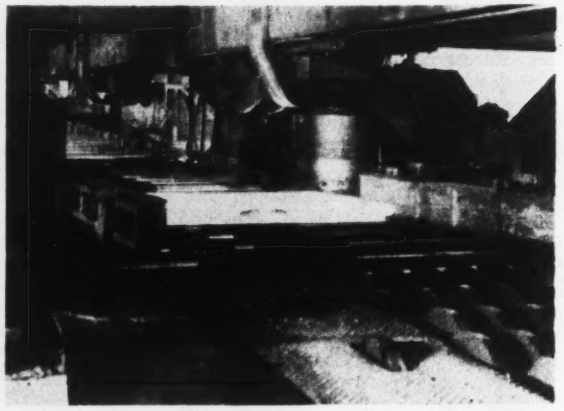

FIG. 5 COMMERCIAL-SIZE TITANIUM SLABS WEIGHING ABOUT 1000 LB EACH AND $2^1/_2$ IN. THICK ARE ROLLED TO $^5/_8$-IN-GAGE PLATE BY LUKENS ON ITS 120-IN. AND 206-IN. ROLLING MILLS

HEAT-TREATING FURNACE

Continuing to stress bigness in its expansion program, Charles Lukens Huston, Jr., president of Lukens, revealed that construction is under way on the largest continuous heat-treating furnace in the world for the company. This furnace is another step in the $22 million expansion program currently being carried on at Lukens, and will be capable of heat-treating armor plate, alloy steel, and carbon-steel plates.

The annealing line, with an over-all length of 365 ft, consists of a 50-ft charge table, 202-ft roller hearth furnace, 10-ft transfer table, 1000-ton quench press 42 ft long, and a 50-ft discharge table arranged to swing 90-deg for crane pickup of the plates. All conveyer rolls, furnace doors, and discharge-table swing mechanism will be motor-operated and controlled by one man from a control house located adjacent to the quench press.

Plates up to 130 in. wide × 480 in. long, $^3/_{16}$ in. to 2 in. thick, and with a temperature range of 950 to 1950 F, can be handled by this equipment. The heat-treating cycles will be variable from 10 min to 12 hr to accommodate the wide variety of stainless and other steel analyses for which this new equipment is intended. The rated capacity for stainless-steel annealing is 13,250 tons per month.

The furnace proper will have a door opening 12 ft 2 in. wide × 2 ft 6 in. high, and an effective length of 202 ft. In order to minimize marking of the work, the furnace conveyer will consist of 14-in-diam rolls on 16-in. centers of potential refractory construction. To minimize heat loss from the rolls, they will be water-cooled and insulated. Special provision will be made to remove and replace the rolls quickly.

Driving the furnace rolls will be roller-chain-engaging sprockets on each roll. Mechanically synchronized to avoid scratching of the work, the drive will be in four sections. The main drive unit will employ a hydraulic variable-speed transmission with electric remote control for variation of the hearth speed. Quick delivery of annealed plate to the quench press will be assured by a high-speed runout section 40 ft long provided at the discharge end.

Combination natural gas or oil luminous flame burners will fire the furnace directly. Temperature control will be proportioning and divided into 10 zones of 20 ft each. The maximum fuel capacity will be 135,000 cfh of natural gas or 960 gph of oil. Necessary safety equipment will be incorporated in the combustion system.

The quench press will have an effective bed 10 ft 10 in. wide × 40 ft long, a maximum opening of 24 in., and a maximum rating of 1000 tons. Work will be conveyed into and out of the press by driven steel rolls mounted on a hydraulically retractable frame that will deposit the work on the lower platen while press-quenching. This press installation will permit the flattening and quenching to be done simultaneously on armor plate and certain grades of stainless.

STEEL HEADS

As an aid to cutting fabrication costs, Lukens spokesmen urged designers and engineers to use steel heads. Originally used entirely for the ends of pressure vessels and storage tanks, heads and head segments are finding additional application in the design and fabrication of machinery components, it was pointed out.

The company spins a wide range of heads, from 12 in. to 20 ft 6 in. in diam; and presses heads from about 4 in. up to 9 ft in diam. Lukens spins the world's biggest one-piece heads on its 276-in. flanging machine—big "hats" weighing as much as 36,000 lb. Thicknesses of heads produced by both methods range from $^3/_{16}$ in. to 6 in.

It is unnecessary for a designer to use a whole head unless the design calls for it, since parts or sections can be effectively used for many applications, it was reported.

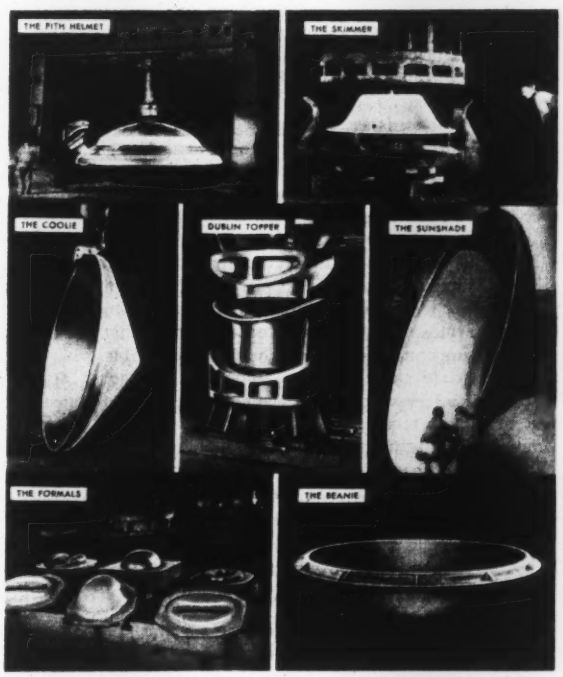

FIG. 6 THIS VARIETY OF HEADS IS PRESSED OR SPUN FROM HEAVY STEEL PLATES, AND FORM TOPPERS FOR SUCH INDUSTRIAL PRODUCTS AS OIL-REFINERY VESSELS, DOMESTIC AND INDUSTRIAL LP-GAS STORAGE TANKS, U. S. COAST GUARD BUOYS, AND THOUSANDS OF OTHER DIVERSE PIECES OF EQUIPMENT

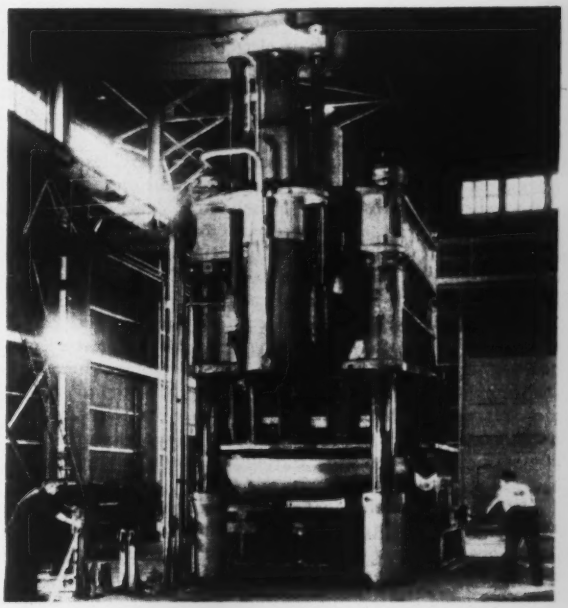

FIG. 7 THE LARGEST HEADS EVER PRESSED—PEAR-SHAPED, WATCH-CASE CIRCUIT-BREAKER TANKS—FORMED OF $^1/_2$-IN-THICK STEEL ON LUKENS NEW 2000-TON HYDRAULIC PRESS

The wide range of available sizes lends itself to many purposes. Practically all kinds of common metals can be formed into head shapes.

Pressed heads are most accurate and uniform, and undergo less thinning of the metal during forming than spun heads. Pressed-head production is faster than spinning, and the cost is lower when large quantities are made. Special dies are justified only when the demand for a particular size is rather large. Lukens, however, has over 5500 major dies, ranging up to 50 tons apiece, worth approximately $12 million—so that most conceivable shapes and sizes can be made with stock dies.

Three methods can be used to modify head shapes for various applications: Material can be removed by flame-cutting, added by welding, or worked with a combination of these two methods. For example, head shapes can be used as integral ends of cylindrical structures, as removable covers for various types of openings (such as the end shields of large squirrel-cage motors), and as circular structural elements such as table bases and as the bases of floor-type fans.

Shapes can be modified by cutting out holes and segments to adapt the head shape for various mechanical functions. For example, up to certain speeds, cast-iron heads have been acceptable as covers for grinding wheels. Now, however, most users demand steel guards irrespective of surface speeds. A steel hood is less likely to shatter than a cast-iron hood, if the grinding wheel breaks at high speed. One well-known grinding-machine company uses a flanged-only steel head for its guards, with a cutout section for working space.

Nuclear-Reactor Monitor

THE design of a packaged automatic control system that electronically monitors the operation of nuclear reactors and their related processes was announced recently by the Industrial Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa.

Planned as a complete integrated control unit, the system will include a multiplicity of electronic instruments—amplifiers, servoamplifiers, recorders, controllers, and servomotors. These will automatically regulate the reactor's control rods and therefore the rate of power generation of the nuclear reactors (atomic piles) at predetermined levels.

The new system, it was pointed out, also provides robotlike safeguards against dangerous operating conditions.

According to George M. Muschamp, Mem. ASME, vice-president of engineering for the division, the new reactor control system will be especially valuable when linked to other automatic equipment to make feasible the conversion of nuclear energy into electrical power by private industry. "Power generation," he explained, "requires absolute control of a variety of conditions including temperatures, pressures, and flows. With atomic energy as the primary source there is the additional problem of instantaneously proportioning the nuclear reaction to these conditions. This will be accomplished by integrating the reactor control system with recording and controlling instruments to electronically co-ordinate all of these operating conditions."

In conventional procedures for designing the control systems for atomic piles, Mr. Muschamp pointed out, the responsibility generally has been left to the Atomic Energy Commission.

It purchased the control instruments and developed its own regulating systems which varied from installation to installation. By centralizing such control setups into a "packaged" system, the unit costs will be markedly reduced, design time speeded up, and control efficiency increased, Mr. Muschamp stated.

Initial function of the new reactor control system, Mr. Muschamp said, is to guarantee a "safe start-up" of the chain reaction. This chain reaction commences when the nucleus of a uranium atom is split under neutron bombardment. As it splits it releases more neutrons. These, in turn, split additional nuclei, releasing more neutrons, thus producing a chain reaction. To sustain this reaction a specified number of neutrons must be liberated per second.

As the control rods are removed to begin this chain reaction, a neutron-sensitive detector in the reactor itself sends out tiny "pulses." These are picked up by an electronic amplifier—one pulse for each neutron detected by the chamber. Another electronic device counts these pulses, totaling them on a digital register. The operator, by determining the number of pulses occurring per second (or any given period of time) knows the rate at which the reaction is increasing and adjusts the control rods accordingly. As the reaction increases, still another electronic instrument, a counting rate meter, integrates these pulses, translating them into voltage readings proportional to the number of pulses detected per second. The over-all effect is to provide the operator with an automatic means of sensitively regulating the early stages of the chain reaction.

During this entire start-up process, and after the proper operating level has been reached, other electronic units in the control system are continually monitoring the reaction. For example, one series of electronic amplifiers and recording instruments monitor the reaction for too rapid a rise in power level. If the units detect any abnormality they immediately shut down the reactor. Another series of amplifiers act to prevent the power level from going too high. Should this occur they also will immediately shut down the reactor.

He explained that without these automatic safeguards an atomic pile could not be practically operated. If the chain reaction were permitted to develop unchecked it could result in the actual melting of the reactor itself—which represents an investment ranging from $25,000 to $50,000,000—and the releasing of radioactive material that would contaminate the area and endanger nearby personnel.

Once the reactor is safely started and at the desired operating level, a final control series take over to regulate continuously the chain reaction at previously determined levels. To accomplish this, a specially developed instrument called an electrometer records the power level, signaling servoamplifier units. These units, linked to special servomotor equipment, will automatically adjust the control rods to regulate the nuclear reaction.

An example of the automatic control of associated processes, in addition to the nuclear reaction, lies in the cooling function. Mr. Muschamp explained that atom splitting generates tremendous quantities of heat. He cited the reactor at Brookhaven National Laboratories, Upton, Long Island, which produces some 720,000 kwhr of energy each day. This, he said, is equivalent to the energy requirements of a town of a population of 6000. Accordingly, large volumes of coolant are required to prevent the reactor from overheating. A specially developed cooling system will utilize a variety of automatic control devices to regulate air temperature, pressure, and flow rates.

High-Pressure Pneumatics

RECENT trends toward high-altitude flight and more efficient utilization of weight and space in aircraft have led to a much wider application of pneumatic systems for performing such high-speed operations as extending and retracting the landing gear, emergency canopy or seat ejection, gun charging, and rocket ejection.

Although compressed air has been used for many years, air-borne pneumatics are still in an early stage of development. Because of the high actuation speeds and operating pressures now being considered, a research program for the study of high-pressure penumatics has been established by the National Bureau of Standards at the request and with the co-operation of the Airborne Equipment Division of the Navy's Bureau of Aeronautics. Although primarily directed toward the needs of military aviation, the efforts of the NBS pneumatics laboratory should find wide application in the aircraft industry as a whole and in other fields of high-pressure technology.

Available facilities include a compressor system furnishing air at pressures up to 500 atm, a specially designed low-temperature box for testing components at temperatures down to —95 F at atmospheric pressure, and an altitude chamber capable of simulating conditions up to a height of 80,000 ft.

The altitude chamber has a working volume of approximately 25 cu ft—sufficient to accommodate an entire pneumatic system. Both temperature and humidity controls permit the simulation of flight conditions at high altitudes, and studies can be made over the entire temperature range from —100 to + 150F.

The low-temperature box contains a 3.75-cu ft test chamber refrigerated by circulating alcohol from an adjacent bath chilled by dry ice. Air under pressure passes to the component under study through a built-in cooling coil. A flow of 150 standard cfm can be maintained through the system for extended periods at —90 F.

The evaluation of pneumatic systems and components involves measurements of pressure and temperature under transient, pulsating, and steady-flow conditions as well as the measurement of volume of steady flow. The equipment used by the pneumatics laboratory for this work has been designed to permit automatic recording, versatility, and mobility wherever possible.

The work of the pneumatics laboratory in the evaluation of

pneumatic systems has been concentrated on two problems: (1) Determination of the factors governing the most efficient storage and working pressure and (2) determination of the pressure and energy losses in pneumatic systems during transient flow.

Preliminary calculations on the first of these problems indicate that storage pressures of 3000 psi are justified and that perhaps even higher pressures may yield further savings in weight and space, but with diminishing returns. The problem is complicated by the variety of possible systems, but there is reason to believe that a rational basis can be developed for estimating the optimum storage and working pressure.

The work on the second problem involves first the study of pressure and energy losses in a pneumatic system during steady flow and then the correlation of these losses with those occurring during transient flow. The results to date give a satisfactory agreement between theory and experiment for steady flow. From a practical standpoint, this means that it is possible to make an a priori estimate of the losses to be expected in any given pneumatic system. The theoretical calculations are now being extended to include experimental results obtained under transient-flow conditions.

Although the primary objective of the pneumatics laboratory is the solution of practical problems in pneumatic design, basic information must be gathered and analyzed in order to understand the relative importance of various design parameters. The laboratory is therefore conducting parallel theoretical and experimental investigations on the physical phenomena associated with the thermodynamics and mechanics of fluid flow.

At present the only published data on the high-pressure properties of air are the Joule-Thomson measurements, which extend to 220 atm. To obtain the data that are needed in this field, the NBS Thermodynamics Section has installed laboratory facilities and apparatus for measuring the pressure-volume-temperature relations of air from the lowest temperatures to 350 K (170 F) and at pressures up to 300 atm. With the application of existing theory, the experimental measurements obtained in this range will permit accurate determination of the thermodynamic properties of air at the high pressures being considered for future designs. The apparatus can also be used for PVT measurements on other technically important gases that have been considered for pneumatic applications.

On the basis of the existing data for the principal constituents of air and the limited data for air itself, tentative tables and charts of the thermodynamic properties of air have been calculated from 2 atm to 5000 psi. The Joule-Thomson coefficient, specific heat, enthalpy, and entropy have been computed as functions of temperature and pressure, and graphs are in preparation.

Studies of many pneumatic components at NBS have revealed several inadequacies in current pneumatic testing practice. Some of the commonly accepted definitions and test procedures have proved to be ambiguous; as a result, it has been necessary to re-examine the bases on which existing tests were set up. A careful analysis has been made of the performance of various components to determine the elements or characteristics that are of real importance to their proper operation.

In the course of this work, a method was worked out for describing the pressure drop across any pneumatic component in terms of a single characteristic curve. This new approach permits the rating of a valve with extreme economy of time and much less ambiguity. Previously, the flow characteristics of a component were described by a family of flow curves, which were plots of flow rate versus downstream pressure for various values of upstream pressure. Numerous careful measurements were necessary to provide the data for such a set of curves. NBS workers investigating the problem found that when the ratio of the downstream pressure to the upstream pressure is plotted against the ratio of the flow rate to the upstream pressure, a characteristic curve is obtained which is unique for the component under study.

Moreover, inasmuch as analytical formulas are available for plotting these characteristic curves, and they all have one point in common—any given characteristic curve is completely determined by specifying one other point. Thus the NBS study shows that the complete behavior of a pneumatic component can be specified simply by the measurement of a single value of the flow rate for a given value of the ratio of downstream to upstream pressure. The value of the flow rate where the ratio of pressure is $^1/_2$ has been designated the "flow factor" and is used by the Bureau to describe the complete behavior of a pneumatic valve in terms of a single quantity. The flow factor is a constant for a given component; and once it is determined, either by experiment or theory, it can be used to predict valve performance for a wide range of upstream conditions. It is also possible to combine analytically the flow factors of a number of valves into an over-all flow factor, which will serve to determine the behavior of the more complex system composed of the separate valves in series.

Since its establishment, the NBS pneumatics laboratory has made progress in the development of facilities, instrumentation, and experimental and theoretical techniques for the analysis of pneumatic systems. A continual effort has been made to maintain a balance between the practical and sometimes urgent requirements of the designer and the more basic aspects of the problems studied. It is felt that time spent on the more fundamental studies will eventually be of great value in the solution of technical problems arising in pneumatic systems where high flow rates, short response time, and rigid cycling schedules are specified.

Radiamatic Pyrometers

THE development of radiation detection devices that are said to be 10 times faster and 2 to 5 times more accurate than previous systems in monitoring critical temperatures during uranium rolling operations, were reported recently by the Industrial Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa.

The new system was designed to supervise automatically this vital phase of production rolling of uranium ingots, and has been installed in the recently opened uranium mill built by Birdsboro Steel Foundry & Machine Company, Fernald, Ohio. The AEC's Ohio production center is now in volume production rolling uranium into ingot bars later used to produce fissionable materials.

Objective of the system was to improve the accuracy of temperature measurements which are important to uranium and other rolling processes. Called radiamatic pyrometers, the radiation devices function as "pickup" elements which are comparable to electric eyes. They detect the temperature—or heat—of the uranium ingot and relay the information to a series of electronic recording instruments. This information, which may report temperature conditions at several points in the production line, permits a single operator to make necessary adjustments.

Usually, mill operators determine temperature by utilizing colored crayon sticks, each with specific melting points. To ascertain ingot temperatures the operator stops the operation and marks the ingot with the crayon stick. If the crayon stick with a melting point of, say, 1000 F, melts on application, the operator knows the ingot is at least that hot. A crayon stick

with the next highest temperature is then applied. If this doesn't melt, the operator then calculates the ingot temperature lies somewhere in between.

By permitting measurements while the ingots are being processed, the new M-H system markedly speeds up the production operation. Estimates indicate that the new electronic system provides a temperature reading, at one or a dozen points, in about 1 or 2 seconds, or 10 times faster than the crayon method. The accuracy of the temperature reading is also improved, ranging from 2 to 5 times better.

The automatic monitoring is similar to systems developed by the company for use in steel mills to determine temperatures of processed steel.

High-Pressure Turbosupercharger

A NEW turbosupercharger has been designed and developed by De Laval Steam Turbine Company, Trenton, N. J., specifically for high-pressure supercharging service. As described by Rudolph Birmann, Mem. ASME, consulting engineer for De Laval, the series A model, which has been built in two different sizes—the A-10 and the A-14—is designed for a pressure ratio of 2:1 under full-load engine operating conditions, and slightly higher under engine overload conditions. The later models are being planned to be capable of producing pressure ratios of 3:1 under engine full-load conditions.

The compressor is of the mixed-flow type, so-called because the air enters axially and flows through and out of the impellers partly axially and partly radially. This type of compressor, it is claimed, gives efficiencies and performance characteristics which are substantially better than those which can be achieved with either the axial-flow type or the radial-flow centrifugal type, the latter being commonly used in conventional turbosuperchargers.

A departure from conventional practice was also made in the design of the turbine, because it was found that the desired turbine characteristics and high turbine efficiency could not be obtained by using the conventional axial-flow type of turbine. The mixed-flow centripetal turbine was found to be much more suitable for service in exhaust-gas-turbine-driven superchargers.

An attractive feature of the centripetal turbine is the fact that its blades are rugged and they are few in number. In the axial-flow turbine many more blades are necessary, and therefore they must be comparatively narrow and delicate.

FIG. 9 CENTRAL PARTITION ASSEMBLY WITH TURBINE HOUSING

The De Laval turbosupercharger is also unique with regard to the construction of its rotor. The mixed-flow impeller and the centripetal turbine wheel are combined in a single rotor structure in which the compressor blading is carried on one side of the rotor hub and the turbine blading on the opposite side. This arrangement eliminates all parasitic losses such as turbine and compressor leakage, windage, and friction of nonworking surfaces—losses which are said to be unavoidable in conventional designs employing separate compressor and turbine rotors. By eliminating these losses, the turbine and compressor efficiencies are substantially improved, over and above the improvements already achieved by the aerodynamically highly improved mixed-flow compressor blading and the refined centripetal turbine-blade configuration. This so-called "Monorotor" construction offers the additional advantage of extreme simplicity, eliminating a great number of parts such as air and gas seals and partition walls.

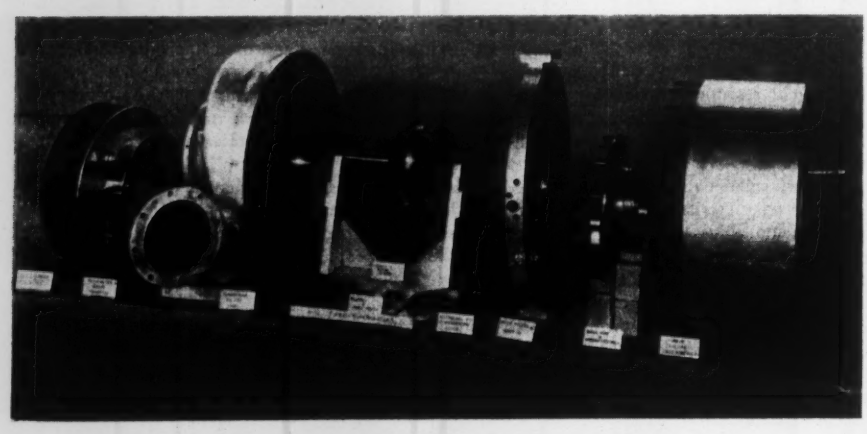

FIG. 8 EXPLODED VIEW OF DE LAVAL TURBOSUPERCHARGER

The blades of both the compressor and the turbine are open along their entire tip contour, and their configuration prevents accumulation of dirt, with its resulting loss of performance.

The overhung rotor is bolted to the end of the shaft by means of a single central tie bolt. The shaft is journaled in two bearings, located on the cold side of the rotor and contained in a common bearing housing that is an integral coaxial part of the compressor inlet casing. Both bearings are of the steelbacked, copper-lead-lined type.

The mixed-flow compressor

has an axial air inlet and a vaneless diffuser, terminating in a scroll housing, from which the air is discharged tangentially. The use of a vaneless diffuser is largely responsible for the wide compressor operating range, and makes the compressor capable of efficiently serving a variety of engines having different air-flow requirements.

The turbine nozzle box receives the engine-exhaust gases in a tangential direction, through a single inlet, and contains the turbine nozzle guide vanes which provide for full admission in all applications. These guide vanes are arranged between two radial walls, and are so mounted on one of them that they can readily be pivoted to change the nozzle area. This feature eliminates the need for installing different nozzle rings to adapt the unit to different operating conditions, and permits rapid matching of engine and turbosupercharger. In some units a mechanism has been incorporated which permits adjusting the guide-vane position from the outside, during operation of the turbocharger. This externally adjustable guide-vane mechanism is invaluable when used as a tool to perform rapidly a series of tests leading to the best matching of turbosupercharger and engine. It can also be used for varying the turbosupercharger rpm with changing engine load or speed, to achieve various engine operating characteristics, such as high torque at low engine rpm.

The guide vanes direct the flow of exhaust gases radially inward into the turbine blades, from where they are discharged into the passages formed by the blades of the turbine wheel. The exhaust gases are then discharged into an exhaust diffuser, which is coaxial with and a part of the turbine housing. This diffuser serves to recover some of the kinetic energy represented by the leaving velocity at the discharge from the turbine blades and to convey the gases to the turbine discharge opening.

FIG. 10 TURBOSUPERCHARGER COMPLETELY ASSEMBLED INCLUDING TURBINE LAGGING AND PULSE CONVERTER

The turbine housing is made from a heat-resisting alloy, and is insulated and lagged instead of being water-cooled. The turbine nozzle box is separated from the compressor housing by a central partition diaphragm, which is hollow for internal water circulation. It is the only water-cooled part of the entire unit. Tests have shown that the amount of heat rejected to the small quantity of cooling water required is insignificant compared with the heat carried away in the cooling water for the commonly used turbine casing cooling jackets.

The Monorotor construction of the turbine wheel and the compressor impeller permits cooling the turbine side of the rotor in a simple manner, by by-passing approximately 5 per cent of the air handled by the compressor over the periphery of the rotor to the turbine. The air so by-passed flows in the form of a thin sheet over the turbine rotor hub, blanketing it from the heat of the gases. This cooling effect is augmented by the provision of cooling air flow through the hollow interior of the rotor and through cooling passages directly adjacent to the turbine-blade roots. By being intensively cooled in this fashion, the turbine is capable of safe operation with the highest temperatures encountered in diesel-engine service, because the metal temperatures are reduced to values for which the time-to-rupture is virtually unlimited.

The full admission of the turbine and its undivided nozzle box is another feature of the De Laval supercharger. Full admission is necessary if maximum turbine efficiency is to be achieved. Full admission is not possible, however, in conjunction with the well-known "blowdown" or Buchi system, which has found wide application to four-cycle diesel engines. The objective of the Buchi system is the utilization of as much of the pulsating exhaust energy as is possible. For this purpose the engine exhaust manifold is subdivided into separate branches, so arranged that the exhaust gases from any one cylinder, or from groups of two or three cylinders having non-overlapping exhaust periods, are segregated and discharged into the turbine through separate groups of turbine nozzles. This involves, momentarily at least, partial turbine admission and pulsating flow through the turbine—both of which adversely affect the turbine efficiency. The De Laval turbine operates with full admission and steady flow at all times. To recover the pulsating portion of the exhaust energy, the several branches of the exhaust manifold are connected to the single turbine inlet by means of an adaptor piece called the "pulse converter adaptor." This device is capable of converting the pulsating portion of the exhaust energy into a pressure rise, with the result that the preturbine pressure is higher than the mean pressure in the exhaust manifold. The difference between preturbine pressure and mean exhaust manifold pressure represents that part of the energy of the exhaust pulsations which is made available to the turbine. The turbine, by virtue of its full admission and steady flow, can then convert this energy, with maximum efficiency, into net output.

Compact Air Sampler

A PORTABLE, compact instrument which can be used to collect samples of gases, dusts, and vapors in workroom atmospheres and which can also be used for stack sampling was announced recently by Compact Air Samplers of Demarest, N. J.

The complete assembly weighs under 15 lb and occupies about the same space as a portable typewriter. A feature of the unit is that all the necessary apparatus for accurate air sampling, including a small, lightweight suction pump, are mounted within the case. The entire unit can be mounted on a sturdy metal tripod which comes with the instrument so that manipu-

FIG. 11 PORTABLE COMPACT AIR SAMPLER

lation of the apparatus can be accomplished at convenient breathing level.

The air pump used for drawing air through the glass scrubbers operates from 110 volts a-c. The scrubbers are of the usual small impinger type but in operation are capable of being used for longer periods of time because of the provision of a glass trap which prevents any liquid from reaching the rotameter and pump. Space is also provided for three small reagent bottles for carrying sampling solutions into the field and for extra rubber tubing if it is desired to sample some distance away from where the unit is stationed.

Simplification of air and stack sampling is achieved by reducing manipulations to a minimum and for samples which require simple analysis the incorporation of test kits is a distinct possibility if immediate analysis is desirable.

Since most gases and vapors encountered in industrial atmospheres and stack emissions are of the type which must first be collected, the instrument has been designed for general purposes of air sampling. Thus gases such as sulphur dioxide, ammonia, hydrogen sulphide, formaldehyde, and vapors of halogenated hydrocarbons, alcohols, ketones, and other organic solvents are easily collected for analysis. Other applications lie in the collection of inorganic dusts for dust counts, air-borne insecticidal dusts and sprays, and air-borne bacteria.

Electronic Elevatoring

NEW developments in elevators were demonstrated by the Otis Elevator Company at an initial showing, July 14, in the Biltmore Hotel, New York, N. Y.

A model of a ten-story building, containing a fully automatic model-elevator system, revealed how an electronic control enables a bank of four elevators to analyze passenger requirements and to select the correct traffic program to handle these requirements without human intervention.

Coincident with announcement of the new developments, LeRoy A. Petersen, Otis president, disclosed that public acceptance of "without attendant" elevators is taking place so swiftly that Otis expects 80 per cent of the cars it sells in 1953 for office buildings to incorporate the operatorless feature. Rapidity of the trend is shown by the fact that three years ago, in 1950, only 12.6 per cent of the Otis elevators sold for office buildings were operatorless. The figure rose to 32.7 per cent in 1951, and to 58 per cent last year. During the first quarter of 1953, about 75 per cent of the Otis elevators sold for office buildings included the operatorless feature, Mr. Petersen added.

He disclosed that the model also is serving Otis engineers and researchers as a miniature "laboratory" in the development of even more advanced devices for the elevator of tomorrow.

A number of traffic patterns, which might occur in any type of elevator-equipped building, were set up on the control panel of the demonstrator to show how the electronic control assumes the entire burden of analyzing traffic, timing the changes in pattern to meet varying requirements, and selecting the correct traffic program. The system adjusts itself automatically to handle any one of six different traffic patterns throughout the day. The programs are balanced up-down, heavier-down, heavier-up, up-peak, down-peak, and intermittent.

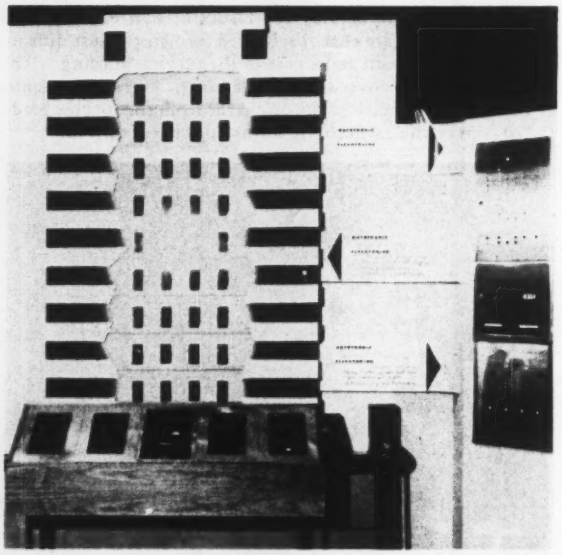

FIG. 12 SETUP USED TO DEMONSTRATE THE ELECTRONICALLY CONTROLLED ELEVATOR SYSTEM INCLUDES A 10-STORY MODEL BUILDING (*left*), A CONSOLE (*below*) WITH PANELS OF ELECTRONIC TOUCH BUTTONS CORRESPONDING TO THOSE IN AN ELEVATOR CAR AND AT LANDINGS, AND A SUPERVISORY CONTROL PANEL (*right*) SIMILAR TO THE TYPE THAT WILL BE INSTALLED IN BUILDING LOBBIES

Thus the electronic control provides, automatically, for efficient handling of the morning rush hour when "up" traffic is at a peak, restores a balanced program between peaks, sets the system again to handle the increased lunch-hour volume, both down and up, and switches to the down-peak program at closing time in the afternoon. In addition, the intermittent program automatically goes into effect during evening hours and on holidays when traffic is light and there is no need to keep all elevators in operation.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Boiler Feedwater Studies

Progress in the Study of Corrosion in the Moisture Region of Large Steam Turbines, by T. W. Bigger, Mem. ASME, J. F. Quinlan, and C. C. Carson, General Electric Company, Schenectady, N. Y. 1953 ASME Semi-Annual Meeting Paper No. **53—SA-12** (mimeographed).

TESTS to compare the resistance of various actual and possible steam-turbine materials to corrosion-erosion were run using wet steam extracted from an operating turbine. To determine the cause of the corrosion, chemical studies were made of the liquid phase, herein called initial condensate, at the temperature and pressure of the dew point in the turbine. It was learned that the pH of the fully condensed steam from the same point and the sulphur compounds from boiler sulphite were a principal cause of the lowered pH with its attendant corrosion.

A program was laid out whereby actual and prospective turbine materials could be compared under corrosive conditions duplicating turbine service as closely as possible. Testing was done in wet steam extracted from a turbine where corrosion was known to exist. A prominent New England utility company permitted the tests to be run in one of their stations. The turbines in this station are 40,000-kw, 3600-rpm, 21-stage, tandem-compound, double-flow turbines, operating with initial conditions of 1200 psig and 900 F. The dew point occurs in the 14th stage at design load and, since there is an extraction at this stage, steam for the tests was taken from the 14th-stage extraction line through stainless-steel pipes. The test-apparatus inlet valve was run wide open and most of the pressure drop occurred through the restriction in the specimens. The inlet pressure to the specimens was, therefore, very near the 14th-stage pressure. A short section of uninsulated pipe supplied steam to each tester from the top of a drained header to insure that equal amounts of fresh condensate would be supplied to all metal specimens.

According to the paper, good pH equipment was used and the chemical determinations were made by the methods of microchemistry. A statistical study of the relationship of various boiler-water treatments to corrosion in representative power stations is being carried on. Plans are being made for additional chemical studies in other power stations. This paper is a progress report, to apprize the power industry of what has been accomplished. The final solution will be largely a local problem because of the wide variety of pressures, temperatures, boiler-feedwater treatments, and methods of make-up preparation in different plants.

Reduction of Condensate-Line Corrosion, by Scott Jensen, Southern California Edison Company, Los Angeles, Calif., and E. Russell Lang, Mem. ASME, Hall Laboratories, Inc., South Gate, Calif. 1953 ASME Semi-Annual Meeting Paper No. **53—SA-15** (mimeographed; to be published in Trans. ASME).

GENERAL accumulation of iron and copper oxide or copper on boiler surfaces during service is almost always due to corrosion by water in the preboiler system beginning at the point where steam first condenses. The reduction of this corrosion will result in cleaner boilers and permit longer operation of the boilers between cleanings.

This paper reports progress made in reducing iron and copper corrosion using ammonia, cyclohexylamine, and sodium sulphite. The work was done at the Southern California Edison Company steam plants. This company supplies electric power to a large portion of Southern California by means of its hydro installations and its four steam plants. The reduction of corrosion in the condensate system at the Long Beach Steam Station and at the Redondo Steam Station is discussed.

The following conclusions are drawn from this investigation:

1 A major part of the corrosion in the system investigated occurs between the point of first condensation in the turbines and the condensate-pump discharge.

2 Corrosion of iron occurred in the portions of the system immediately following the first condensation of steam even though sufficient ammonia was

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naturally present in the steam to maintain a pH of 8.5 at the condensate-pump discharge.

3 Feed of cyclohexylamine once a day provided better protection to both iron and copper alloys than was afforded by the ammonia naturally present in the system.

4 Continuous feed of cyclohexylamine along with sodium sulphite at the condensate-pump discharge still further reduced the iron and copper content of the condensate and of the boiler feedwater. Low levels of 0.02 ppm of Fe and 0.01 of Cu in the condensate have been attained in two plants.

5 No increase in ammonia content of the condensate has been observed as a result of the continuous feed of cyclohexylamine to a boiler producing steam at 900 F.

The Mitigation of Marine Fouling by Anaerobic Treatment, by H. T. Duplice and R. C. Alexander, Mem. ASME, Department of Water and Power, City of Los Angeles, Los Angeles, Calif. 1953 ASME Semi-Annual Meeting paper No. 53—SA-18 (in type; to be published in Trans. ASME).

THIS paper deals with the killing of marine-fouling organisms, particularly the bay mussel, in salt cooling-water conduits by anaerobic treatment.

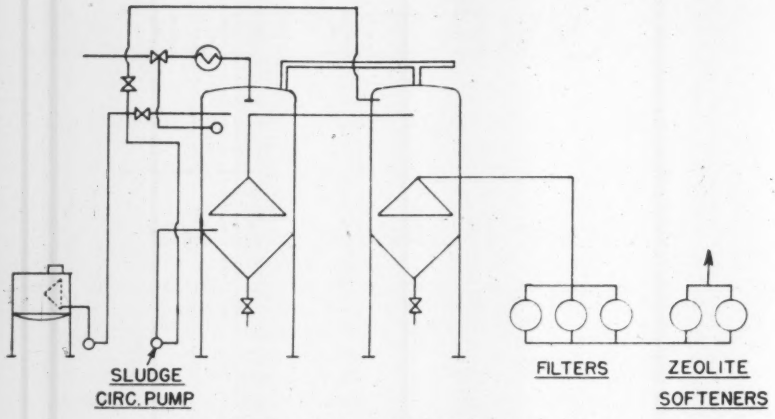
In a parallel two-tunnel system it was found possible to make efficient "kills" by removing one of the tunnels from service and preventing the entry of new water into it. The marine life within the tunnel consumed the dissolved oxygen and subsequently died from the resulting anaerobic condition.

Removal of the dead shells after treatment was accomplished by velocity cleaning—obviating the necessity of dewatering for mechanical cleaning.

Zeolite Vs. Soda Ash in Hot-Process Softener at Firestone, by W. F. Fields, Firestone Tire & Rubber Company, Los Angeles, Calif. 1953 ASME Semi-Annual Meeting paper No. 53—SA-13 (mimeographed).

HOT zeolite treatment preceded by a hot-process lime treatment replaced soda ash at the Los Angeles plant of the Firestone Tire and Rubber Company in supplying quality feedwater to the plant's steam-generating equipment. This paper describes the plant's experiences with zeolite.

In 1928 a hot-process-lime soda softener, consisting of a 10-ft-diam × 22-ft straight-side cone-bottom softener and one $8\frac{1}{2}$-ft-diam × 7-ft straight-side



FLOW DIAGRAM OF FIRESTONE'S LOS ANGELES PLANT

anthrafilt filter, was installed to handle feedwater requirements for the 60,000-lb per hr boilers and the evaporators. In 1935 a second-stage reactor having a 17-ft-diam × 22-ft straight-side cone bottom was added in series with the units previously mentioned. Two additional anthrafilt filters were added to the system bringing the total feedwater-treatment capacity to 135,000 lb per hr. The system operates at 5 psig pressure. Phosphate addition to the feedwater is accomplished by internal feeding into the boilers.

In summarizing, the results obtained from the second-stage hot-zeolite softener have confirmed and in some ways exceeded the expectations of the company's engineers. The quality of the feedwater effluent is improved, as have sludge conditions in the boilers. Feed lines are being descaled, blowdown decreased, and an appreciable decrease in operating cost is being effected.

A Preliminary Investigation of Iron-Oxide Deposition in Boiler-Feedwater Systems, by E. G. Gothberg, Mem. ASME, H. Kehmna, and E. S. Johnson, Pacific Gas and Electric Company, San Francisco, Calif. 1953 ASME Semi-Annual Meeting paper No. 53—SA-19 (mimeographed).

THE deposition of iron compounds in the feedwater cycle of a 100,000-kw unit on the Pacific Gas and Electric Company's system has been under investigation for some time. The seriousness of the problem was recognized when the secondary boiler-feedwater pumps of Unit No. 2 lost up to 20 per cent of their capacity. The pump internals were coated with a black, hard, tenacious deposit thick enough to interfere with the flow.

The deposit was essentially a mixture of ferrous and ferric oxides corresponding to about 90 per cent ferroso-ferric oxide, 7 per cent ferrous oxide, and a trace of metallic iron. The condition was recurrent in intervals varying from 140 to 1500 operating hr.

The basis of formulation of such deposits is discussed in the light of analytical work performed to date. A mechanism is postulated for the formation and deposition of iron compounds, which will deposit as hard incrustations. The equilibrium conditions which represent the approximate line of demarcation between formation of soft nonadherent and hard adherent deposits are also discussed.

This investigation is incomplete at present and is being continued. Worl is now being done on the catalysis of th oxidation reaction in the low-tempera ture regions, that is, before and in the deaerator. The authors believe that the chloride content of the condensate and feedwater of the salt-water-cooled plants is the natural catalyst, apparently existing in these systems, and may account for the difference in the type of iron deposition experienced in these different plants. A possible catalyst mechanism is the substitution of a hypochlorite oxidation intermediate, with its lower potential barrier, for the slower hydrogen-peroxide intermediate of purer waters.

On this basis the authors are experimentally maintaining a definite sodium-chloride concentration in the concentrated boiler water and depending upon the natural carry-over of the boilers to provide a small but not negligible sodium-chloride concentration throughout the water cycle. Experience to date indicates that the sodium chloride does circulate and does actually alter the oxidation reaction rates. It seems that the method has a good chance of success in influencing the mechanism of iron

precipitation and dehydration so that harmless forms are deposited.

Recirculating Cooling-Water System at Tucson, by J. H. Saunders, The Tucson Gas, Electric Light & Power Company, Tucson, Ariz. 1953 ASME Semi-Annual Meeting paper No. **53—SA-14** (mimeographed).

THIS paper discusses the water trouble which occurred at the DeMoss Petrie Steam Plant of the Tucson Gas, Electric Light and Power Company when it went on the line using zeolite-softened water for the recirculating cooling-water system. Water for the recirculating cooling system is taken from wells on the property and there are two cooling towers in service.

The trouble occurred after several months of operation. It showed up in delignification of the wood in the tower, corrosion in the piping, condenser, water boxes, and costs. Operation with acid for pH control and metaphosphate for corrosion control was tried and is proving satisfactory.

It was concluded that three factors are outstanding in the use of acid metaphosphate treated water. The tower is being protected, piping and condenser corrosion is greatly retarded, and substantial savings are being made in chemical costs.

Ion-Exchange Equipment in the Treatment of Boiler Make-Up Water—Experiences During Early Stages of Operation, by A. A. Lingo, California Electric Power Company, Riverside, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-59** (mimeographed).

USE of demineralizer units for the production of water suitable for high-pressure high-temperature boilers at central power plants is becoming more and more prevalent, the paper states. With the advent of the completely outdoor power plant, the demineralizer has become one of the features which falls in step with the present trends.

Because this type of water treatment has not been used extensively in power plants, it is necessary to solve a multitude of small problems which are always present when a newly designed piece of equipment is first put into operation. This paper outlines some of the problems encountered in getting the demineralizer unit at Highgrove Steam Plant, Riverside, Calif., to operate as per specifications. To date the unit has been in operation for almost a year with satisfactory results. Additional tests and studies are being conducted to set up procedures and small changes in design which will result in water of even better quality at a more economical cost.

This paper also gives the cost of producing demineralized water and the analyses of raw water, demineralized water, boiler feedwater and boiler water, and data pertinent to their control at this plant.

It is concluded that demineralizer units, because of their independence from heat balance and load conditions of the plant and the better quality of water produced, have demonstrated that they are ideally suited for central power-plant work. The unit at Highgrove has proved to be reliable, safe, and easy to operate.

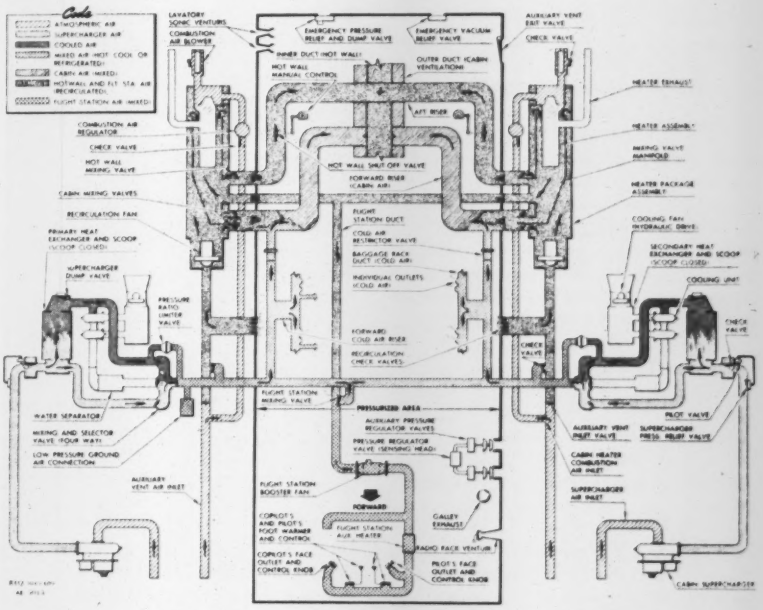
The most expensive and critical item involved in the operation of the demineralizing unit is the caustic soda. Therefore its control is of paramount importance. All the chemical reactions involving caustic must be carried out at the proper temperature, pumping, and timing conditions in order to produce water at a favorable cost.

Aviation

Air Conditioning the Super Constellation, by B. L. Messinger and H. M. Cousins, Lockheed Aircraft Corporation, Burbank, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-31** (mimeographed).

THIS paper summarizes the development of the Lockheed 1049 air-conditioning system, describes the detail components, and lists the design objectives. Tests on ground refrigeration indicated that the most critical cooling requirement was easily met and that the system was capable of rapid temperature reduction under the most stringent condition. Night flight tests indicate the satisfactory capability of the heating system and the uniformity of the cabin-temperature distribution. The Lockheed 1049 air-conditioning system has greater capabilities for maintenance of passenger comfort than has been provided in any previous aircraft, the paper states.

Compliance of the heating system with the heating-design requirements was demonstrated during a special cabin-heating flight test. This test was made at altitudes above 20,000 ft in order to obtain the lowest available ambient temperature (—35 F), and at night to eliminate solar radiation. Several separate heating tests were made during this flight, and each run was sufficiently long to obtain stabilized conditions. The heaters were operated at emergency override position in order to obtain the maximum heater output. Because of this and the fact that the ambient temperature was above the design ambient (—60 F), the average cabin temperature was high (102 F). From this test information it was determined that at the design ambient temperature of —60 F, the average cabin temperature would be 76 F which meets the design requirement of 75 F. The maximum tempera-



SCHEMATIC DIAGRAM OF SUPER CONSTELLATION 1049 AIR-CONDITIONING SYSTEM

ture variation along the center line of a compartment was found to be 3 F. The maximum variation between compartments was 2 F, showing good air distribution throughout the airplane and compliance with this section of the design requirements.

For example, during the general flight-test program on the 1049, tests were made to determine the adequacy of the refrigeration system during flight. These showed that adequate refrigeration was always available to provide 75 to 80 F cabin temperature.

The Use of Stator-Blade Control to Obtain Wide Range of Compressor Performance for Wind-Tunnel Application, by A. W. McCoy, Jun. ASME, Sverdrup & Parcel, Inc., St. Louis, Mo., and M. J. Brunner, Jun. ASME, Westinghouse Electric Corporation, Philadelphia, Pa. 1953 ASME Semi-Annual Meeting paper No. **53—SA-35** (mimeographed; to be published in Trans. ASME).

THE conventional axial-flow compressor with a variable-speed drive has a limited operating range which makes it inadequate for many present-day applications, according to this paper. The 16-ft × 16-ft propulsion wind tunnel, now being constructed for Arnold Engineering Development Center at Tullahoma, Tenn., may be cited as a typical application requiring an unusually wide compressor operating range. Regulation of an axial-flow-compressor performance by means of controllable stator blades provides an extremely wide range of pressure ratio and volume flow at a constant speed, thus offering a significant improvement over the conventional design. In this paper design considerations and methods of prediction of the performance of axial-flow compressors with stator-blade control are given and discussed. The performance of an experimental compressor designed on this basis is presented. The performance range, extending over a 2–1 ratio of volume flows at efficiencies in excess of 80 per cent, was found to be in agreement with the theoretical predictions.

In general, the paper states, at least three radial stations are required for the calculations, and additional stations would be required for more rigorous treatment. For more elaborate calculations, additional factors of radial streamline shifting, significant radial-velocity components, induced-flow effects, and the like, should be considered also. From a practical viewpoint the increased complexity of the equations for inclusion of such effects does not contribute significantly to the general performance estimation except for operating conditions extremely remote from design values.

Production Capabilities of Large Extrusion Presses and Auxiliary Equipment, by G. E. Moni, Reynolds Metals Company, Phoenix, Ariz. 1953 ASME Semi-Annual Meeting paper No **53—SA-27** (mimeographed).

LARGE extrusion presses are being installed by the leading extrusion producers to meet the demand exhibited by the aircraft industry for larger extrusions. An 8000-ton and a 12,000-ton press are being installed at the facilities of the Reynolds Metals Company, Phoenix, Ariz. These presses and their supporting equipment will incorporate new design features to facilitate the technological advancement of the extrusion process. They will be capable of producing extruded shapes 100 ft long with cross-sectional areas twice the size of those obtainable from existing presses.

The 8000-ton press, which is being designed, built, and installed by the Loewy Construction Company, New York, N.Y., will develop its maximum effort through the use of two main cylinders with a capacity of 2700 tons each and the additive force of a 2700-ton piercer cylinder. It is possible, through the proper selection of these cylinders, to operate the press as a 2700, 5400, or 8100-ton machine. This press will be capable of extruding solid shapes from billets of aircraft-type alloys 17 in. diam × 60 in. long, weighing 1500 lb, and tubular shapes from hollow billets 26 in. diam × 60 in. long.

The 12,000-ton press, which is being designed, built, and installed by the Lombard Corporation, Youngstown, Ohio, will develop its maximum effort through the use of three main cylinders with a capacity of 3000 tons each and the additive force of a 3000-ton piercer. It is possible, through the proper selection of these cylinders, to operate the press as a 3000, 6000, 9000, or 12,000-ton machine. This press will be capable of extruding solid shapes from billets of aircraft-type alloys 23 in. diam × 65 in. long, weighing 2700 lb, and tubular shapes from hollow billets 32 in. diam × 65 in. long.

Air-Conditioning Design Features of the DC 7 Airplane, by G. T. Rowe, Jun. ASME, Douglas Aircraft Company, Inc., Santa Monica, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-38** (mimeographed).

IN the commercial air-transport manufacturing field there has been a continuous effort put forth to make the passenger-carrying airplane faster and more comfortable. Airplane air conditioning has rapidly come into its own right as a major factor influencing these "properties" of a successful transport. Cabin pressurization makes it practical for the airplane to travel at high altitudes where high speeds become economically feasible. By means of the airplane heating system, the passenger rides in comfort regardless of low outside temperature.

More recently, emphasis has been placed on adequately cooling the airplane both in flight and on the ground. The problem involved is to accomplish the objectives, pressurization, and air conditioning with the greatest reliability and with the least weight and complication. This paper outlines the approach taken on the DC 7 to accomplish these objectives, with special emphasis on the cooling problem.

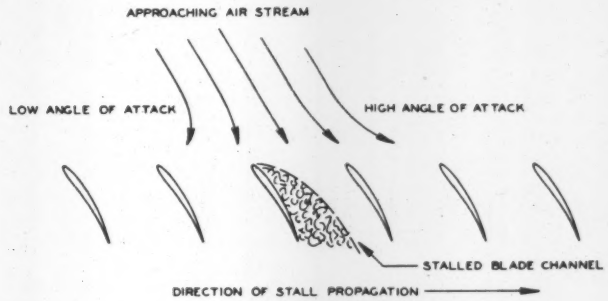
Following the design phase, tests were conducted on individual components and on a complete cabin air-compressor and cooling-system installation. Cooling performance and capacities were verified. Installation, operation, and servicing techniques were established. In general, the entire design was "debugged" prior to installation in any airplane. The final phase is its installation and use in commercial service, another advance in making passenger air travel more comfortable.

Gas Turbine Power

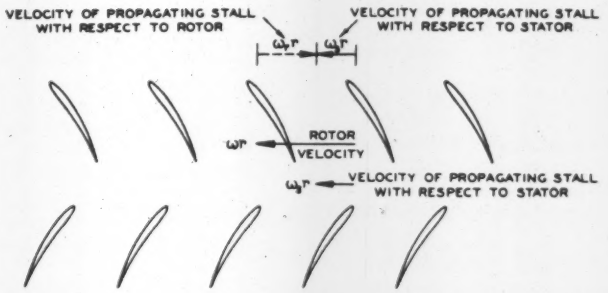
Experimental Investigations of Propagating Stall in Axial-Flow Compressors, by T. Iura and W. D. Rannie, California Institute of Technology, Pasadena, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-69** (mimeographed; to be published in Trans. ASME).

MEASUREMENTS of the velocity fluctuations in stalled operation of an axial-flow compressor have demonstrated that stalling occurs for the most part in well-defined regions over the compressor annulus, this paper states. These stalled regions rotate without changing shape in the direction of the blade rotation with a speed proportional to, but of smaller magnitude than, the rotor speed. Two principal types of propagating stall were observed, one with the stalled region or regions extending over part of the blade height, the other with a single stalled region over the full blade height.

Probably more or less well-defined



STALL PROPAGATION IN A CASCADE



STALL PROPAGATION IN COMPRESSOR-BLADE ROWS

stall-propagation phenomena occur in all axial-flow compressors as they are throttled beyond the peak pressure. Similar phenomena have been observed in centrifugal impellers and even in straight cascades. Pressure or velocity measurements with instruments of low response time give no indication of the propagating stall. Hot-wire anemometers or high-frequency pressure pickups are required for detection of the phenomena.

The propagating stall has been explained qualitatively as a successive unstalling and stalling of blades in a cascade. The stalled-blade channels offer a high resistance to flow through the cascade and the approaching flow tends to be diverted to each side of the stalled region. The incidence angle is reduced to the left of the stalled blades and increased to the right. This tends to stall the next blade on the right and unstall the last stalled blade on the left. The stalled region hence moves to the right. Apparently, as the average flow angle of a cascade approaches stalling incidence, the preferred flow pattern is one with groups of blades severely stalled alternating with groups of unstalled blades rather than a uniform stalling of all blades. The velocity of propagation of the stalled regions is determined by some characteristic time, the origin of which is not definitely understood at present. For a moving cascade, the stall propagation speed relative to a fixed system is the difference between the cascade speed and the propagation speed in the moving cascade. All propagating stall patterns observed moved relative to the compressor casing in the direction of the rotor with a speed less than the rotor speed.

Concepts of Efficiency of Weight and Useful Load Relations in Disk Wheels of Aircraft Gas Turbines, by J. S. Alford, General Electric Company, Cincinnati, Ohio. 1953 ASME Semi-Annual Meeting paper No. 53—SA-72 (mimeographed).

THE concept of design efficiency is combined with analytically derived formulas for the weight and moment of inertia of ideal compressor and turbine disk wheels. An ideal disk is defined in this paper as one having everywhere a constant value of tangential and radial stress due to the centrifugal force of the useful blade load. The weight of the ideal wheel is divided by the weight of the actual wheel to obtain a ratio useful for the following purposes:

1 Comparison and examination of existing designs with the objective of reducing weights.

2 Improvement in the accuracy and the time required for making weight estimates on proposals.

3 Determination of the optimum over-all design for turbine-reducing gear combinations.

Data on the actual weight efficiency of existing representative designs is presented. In addition, data is presented on the effect of blade-fastening design, center bore, and design stress level on wheel weight.

The following conclusions are reached in the paper:

1 The use of weight-efficiency concept gives a rapid method of estimating the weight of new disk wheels.

2 This calculation method provides a rational method of comparing the design excellence of various wheels from point of view of weight.

3 The analysis emphasizes the great importance of keeping the rim weight low if a light and high weight efficiency is to be obtained.

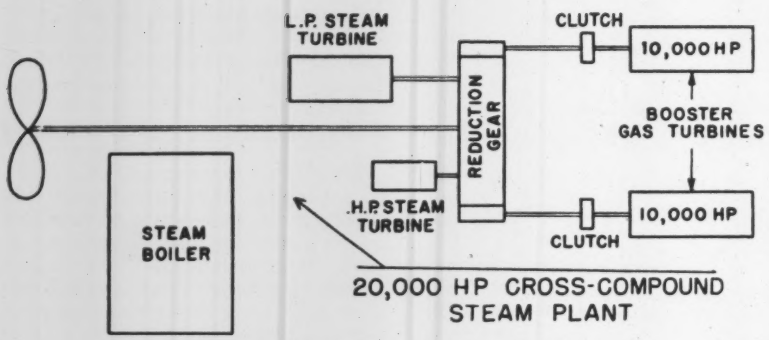
4 A start has been made toward analyzing the various component efficiencies of the elements going to make up the over-all stage weight efficiency. Better quantative data is needed on the blade-to-disk joint efficiency factor, the torque-transmitting shaft or drum-web efficiency factor, and other elements discussed qualitatively in the paper.

5 The weight-efficiency calculation method presented does not take account of all elements in the rotor system. For example, the weights of shafts and shaft extensions, couplings, bearings, and spacers are not included in the individual stage weights considered.

6 Calculations of the polar moment of inertia of new disk wheels can be rapidly made by the efficiency concept and related equations.

Combination Propulsion Plants for Naval Vessels, by J. J. McMullen, Bureau of Ships, U. S. Navy Department, Washington, D. C. 1953 ASME Semi-Annual Meeting paper No. 53—SA-71 (mimeographed).

A MAJOR consideration in the design of a combination plant is the division of power between steam and gas-turbine booster power, this paper states. The optimum division of power must be made on the basis of operational requirements and will depend on the type of vessel, maximum desired cruising speed, the relative machinery weight, and the astern power requirement. At first it would appear that use of the lowest possible cruising power would give the maximum gain in weight of machinery plus fuel, but this is not quite true for several reasons. First, the weight of auxiliary machinery is not proportional to the cruising power. Second, the astern power requirement usually fixes the minimum capacity of the steam base load or cruising plant because boiler capacity must be provided. Third, the operating



COMBINATION STEAM AND GAS-TURBINE PROPULSION PLANT

(This sketch shows one possible arrangement for the port shaft of a typical destroyer. The booster gas turbines may be located in the same compartment with the steam plant or in a separate compartment. In the latter case, the bulkhead would be located between the reduction gear and the clutches.)

time of the gas turbines should be kept to a mimimum.

In determining the division of power, the maximum speed required with the cruising plant is important from an operational point of view because it is desirable, when cruising in formation, not to have to change from one plant to the other. Calculations indicate that a steam-to-gas turbine ratio of about 50 per cent is probably desirable for most light-displacement high-speed combatant vessels. This higher percentage of steam power reduces the maintenance of the gas-turbine portion of the plant and adds appreciably to its life.

The advantages of combination machinery plants are as follows:

1 A decrease in over-all weight and space, resulting in more speed for the same displacement, increased endurance, or greater installed power.

2 A decrease in maintenance and repair; also easier handling during maintenance of the smaller, lighter machinery.

3 Quick-starting. The ship can get under way on the gas turbines alone. This is a limited advantage because the ship cannot be backed down unless controllable pitch propellers or reverse gears are installed.

4 Fast acceleration from maximum cruising power to full power. The gas turbines require a very short warm-up period and will provide quick power.

The main disadvantages of combined plants are as follows:

1 The necessity for selecting a fuel acceptable to the gas-turbine booster units. When the base-load plant does not burn the same fuel as the gas turbines, the percentage of gas-turbine fuel to base-load plant fuel must be decided by operational requirements.

2 The arrangement requires a rather special gear configuration to accommodate the larger number of pinions.

3 Some extra ingenuity is required in disposing the various turbines around the gear.

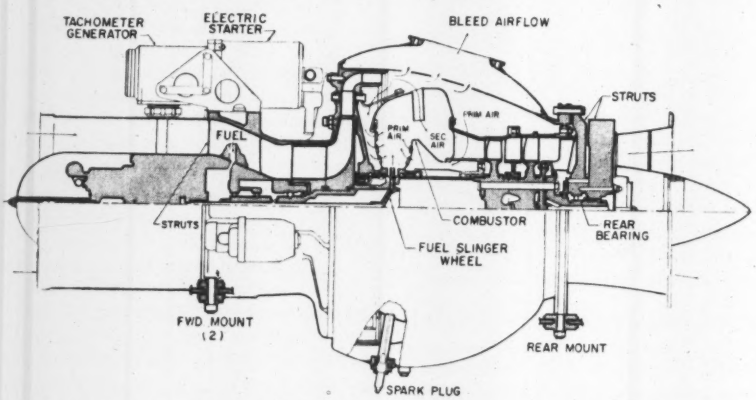
There are several different types of combination plants, such as: (1) Steam and gas turbines, (2) gas turbine and gas turbine, (3) free piston and gas turbine, (4) diesel and gas turbine.

Each of these fundamental types has several possibilities, and are outlined briefly in the paper.

An Application of the Palouste Turbocompressor, by O. H. Jacobson and P. Volkmar, Northrop Aircraft Inc., Hawthorne, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-70** (mimeographed).

IN 1950 Northrop started an airframe design which used a 9000-lb-thrust engine. The engineers, after progressing well into the detail design stage, discovered that no compressors had been developed that were capable of supplying the demands of the pneumatic starter. An extensive survey turned up two components that could possibly be used to furnish the necessary air supply. One was the J-33 turbojet engine which could deliver sufficient compressor bleed air to meet the demand. However, this unit would have been unwieldly and expensive to operate. The second unit was a parallel mating of three of the Navy turbocompressors. These would have supplied sufficient weight flow, but at an insufficient pressure. About this time, Continental Aviation and Engineering Corporation of Detroit began importing a group of small French turbojet engines, one of which functioned as a turbocompressor. This turbocompressor, called the Palouste, met the pneumatic-starter demands remarkably well. The Power Plant Laboratory at Wright Field received the first Palouste for evaluation. Four months later the second Palouste to arrive in this country was put into operation on a test stand.

The Palouste is one of an interesting group of engines developed by Turbomeca of Bordes, France. By interchanging components and by combining basic components differently, Turbomeca engineers developed a group of engines of the same physical size which became either turbojets, turboprops (shaft power units), or turbocompressors. The Palouste turbocompressor was developed to supply relatively large quantities of compressed air to the blade-tip combustion chambers of small helicopters. The Palouste is a conventional gas turbine but produces neither jet thrust nor shaft horsepower. The compressor's major output is bleed air flow. Only enough air remains to support combustion to drive the turbines. Thus it is strictly an air compressor. However, since it operates on the gas-turbine principle, it is called a turbocompressor to distinguish it from other forms of air compressors.



SCHEMATIC CROSS SECTION OF CONTINENTAL-TURBOMECA PALOUSTE I TURBOCOMPRESSOR

It is concluded that the Palouste turbocompressor is well-suited as an air source for high-power turbojet, pneumatic starting systems. Based on this experience, it is felt that the Palouste can be satisfactorily applied to many varied problems of energy transmissions. Further, it is the authors' opinion that in the near future pneumatic power systems will assume an increasingly important place in the aircraft and other allied fields.

Applied Mechanics

Laminar Swirling Pipe Flow, by L. Talbot, University of California, Berkeley, Calif. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-24** (in type; to be published in the *Journal of Applied Mechanics*).

THE problem of the decay of a rotationally symmetric steady swirl superimposed on Poiseuille flow in a round pipe was investigated theoretically and experimentally. The object was to determine the degree to which the rate of decay of the swirl as predicted by a linearized theory agreed with measured rates of decay at flow conditions near the critical conditions for swirl instability. The solution to the linearized equation of motion for the swirl was obtained.

Swirling flow was produced experimentally by rotating a section of the test pipe. Swirl velocities were determined from motion-picture studies of colored oil droplets introduced in the flow. The stability of the swirl was investigated through visualization of a dye filament. A critical curve for swirl instability was determined experimentally relating the angular velocity of the rotating section to the Reynolds number.

The theoretical and experimental values for the decay parameter were found to agree closely, even at conditions of flow near the critical conditions for instability. It was concluded that in the problem under consideration the nonlinear effects are not appreciable for stable decay of the swirl.

Axisymmetric Flow of an Ideal Incompressible Fluid About a Solid Torus, by E. Sternberg, Jun. ASME, and M. A. Sadowsky, Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-7** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper contains an exact solution in series form to the problem presented by the irrotational, axisymmetric flow of an ideal, incompressible fluid past a solid torus of circular cross section. At infinity the fluid is assumed to be in a state of uniform motion parallel to the axis of the torus.

The solution is based on the use of toroidal co-ordinates, and is given in terms of Legendre functions of fractional order as well as complete and incomplete elliptic integrals of the first and second kind. The individual component solutions employed here are interpreted physically through their relation to the basic ring singularities represented by the source ring and the vortex ring.

The problem is first approached via Stokes's stream function exclusively and is subsequently re-solved independently in terms of the velocity potential alone. The convergence of the pertinent series developments is found to be unusually favorable. A complete streamline pattern, corresponding to an illustrative numerical example, is included.

Two-Dimensional Flow Through a Diffuser With an Exit Length, by K. R. Galle, Boeing Airplane Company, Seattle, Wash., and R. C. Binder, Purdue University, West Lafayette, Ind. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-20** (in type; to be published in the *Journal of Applied Mechanics*).

A DIFFUSER with an "exit length" is one with a channel of uniform cross section following the diffuser. Tests were made of different diffusers with and without exit lengths. The data were for steady, incompressible, two-dimensional flow. The performance of each diffuser was improved by the presence of an exit length.

As compared to flow without an exit length, flow with an exit length is characterized by a reduced boundary-layer growth, by a small decrease in the pressure rise across the diverging section, and by a decrease in the static-pressure gradient at the diffuser inlet.

Analog Solution for Beams Excited by an Arbitrary Force, by W. T. Thomson, Mem. ASME, and T. A. Rogers, University of California, Los Angeles, Calif. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-13** (in type; to be published in the *Journal of Applied Mechanics*).

WHEN an arbitrary force acts on a beam, its motion within the elastic range can be expressed by the differential equation

$$EI \frac{\partial^4 y(x, t)}{\partial x^4} + m \frac{\partial^2 y(x, t)}{\partial t^2} = p(x, t)$$

where m is the mass of the beam per unit length and $p(x, t)$ is the intensity of loading.

A formal solution of this equation will result in the displacement expressed by an infinite series of orthogonal functions. This fact is made use of in the method of normal functions which assumes both the deflection and the applied force in terms of such series.

Remarks on Combined Bending and Twisting of Thin Tubes in the Plastic Range, by E. T. Onat and R. T. Shield, Brown University, Providence, R. I. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-18** (in type; to be published in the *Journal of Applied Mechanics*).

THE influence of the loading program on the agreement between the predictions of the Hencky and the Prandtl-Reuss stress-strain relations for a perfectly plastic material is investigated in the case of the combined bending and twisting of thin-walled tubes. The agreement in the values of the bending and twisting moments is found to vary considerably with the particular loading program chosen.

The analysis is extended to tubes composed of a work-hardening material. The bending and twisting moments are obtained numerically using the incremental approach for a square tube which is bent and then twisted. Owing to the large amount of labor involved in this solution, an approximate method using the concept of a "composite" beam is developed. Good agreement in the results is found with those obtained from the incremental solution.

Graphical-Numerical Solution of Problems of Saint-Venant Torsion and Bending, by B. A. Boley, Columbia University, New York, N. Y. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-22** (in type; to be published in the *Journal of Applied Mechanics*).

A SIMPLE successive-approximations procedure for the solution of the problems of Saint-Venant torsion and bending of beams of arbitrary cross section is presented.

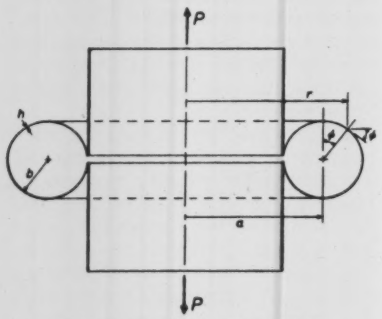
The shear stresses in a cross section of the beam are first calculated from the formulas valid for thin-walled sections,

on the basis of an assumed set of lines of shearing stress. From these a first approximation to the stress function of either the torsion or the bending problem is found. The second approximation to the stress function is then obtained from the governing equation of the problem, expressed in finite-difference form. This in turn allows the determination of an improved set of lines of shearing stress, and hence of the shearing stress itself. The procedure can be repeated until the results of two successive steps are sufficiently close.

Applications are presented for a beam cross section for which the exact solutions are known. It is shown that no further difficulties arise in applications to more complicated shapes.

Toroidal-Shell Expansion Joints, by N. C. Dahl, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-30** (in type; to be published in the *Journal of Applied Mechanics*).

THE problem considered in this paper is shown in the accompanying illustration. A thin toroidal shell of centerline radius *a* and torus mid-surface radius



GEOMETRY OF TOROIDAL SHELL

b is slit at its inner edge and welded to relatively stiff cylindrical pipe sections to form an expansion joint. Stresses and axial deformation under the axial load *P* are desired.

Elastic Spheres in Contact Under Varying Oblique Forces, by R. D. Mindlin, Mem. ASME, and H. Deresiewicz, Jun. ASME, Columbia University, New York, N. Y. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-14** (in type; to be published in the *Journal of Applied Mechanics*).

AN investigation is made of the phenomena occurring at the contact surfaces of like elastic spheres subjected to a variety of applied forces. Owing to the presence of slip, with its associated energy dissipation and permanent set, the changes in tractions and displacements depend not only upon the initial state of loading, but upon the entire past history of loading and the instantaneous relative rates of change of the normal and tangential forces.

On the basis of three of the simplest cases of varying oblique forces, a set of rules of procedure is assembled and then applied to two types of problems. In the first, the initial tangential compliances are calculated for a variety of past histories and instantaneous rates of loading. In the other, a detailed history of a varying oblique force is investigated.

The Shearing of a Rectangular Block Between Rough Plates, by J. W. Craggs, University College, Dundee, Scotland. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-1** (in type; to be published in the *Journal of Applied Mechanics*).

IN a recently published paper, W. T. Read gives an approximate solution of a problem in elasticity which occurs in the testing of materials. This is the problem of determining the stresses in a rectangular block when a pair of opposite faces are mutually displaced in the direction of an edge. The conditions are not those of uniform shear, for that would imply shear stresses on the free faces of the block.

In the present paper an analytical solution of the same problem is obtained and the results are compared for a particular case. The method used is a particular case of the general method described by G. Pickett.

Thermal Stress in Pipes, by Henry Parkus, Michigan State College, East Lansing, Mich. 1953 ASME Applied Mechanics Division Conference paper No. **53—APM-19** (in type; to be published in the *Journal of Applied Mechanics*).

AN incompressible, hot liquid in steady-state-flow condition is flowing through a long tube, transferring heat to the surrounding walls. The outer surface of the tube is kept at zero temperature. Temperature distribution and thermal stress in the tube are calculated.

ASME Transactions for August, 1953

THE August, 1953, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Modern Trends in Hydraulic-Turbine Design in Europe, by G. A. Bovet. (52—A-92)

Pressure Surges at Large Pump Installations, by John Parmakian. (52—A-60)

Pressure Distributions on the Blade of an Axial-Flow Propeller Pump, by D. A. Morelli and R. D. Bowerman.

Laboratory Investigation of Superheater-Tubing Materials in Contact With Synthetic Combustion Atmospheres at 1350 F, by C. J. Slunder, A. M. Hall, and J. H. Jackson. (52—A-36)

Resistance of Cast Fe-Cr-Ni Alloys to Corrosion in Oxidizing and Reducing Flue-Gas Atmospheres, by J. H. Jackson, C. J. Slunder, O. E. Harder, and J. T. Gow. (52—A-37)

Corrosion of Mercury-Boiler Tubes During Combustion of a Heavy Residual Oil, by A. M. Hall, D. Douglass, and J. H. Jackson. (52—A-85)

Thermal Shock and Other Comparison Tests of Austenitic and Ferritic Steels for Main Steam Piping—A Summary Report, by W. C. Stewart and W. G. Schreitz. (52—A-35)

Metal-Cutting Chatter and Its Elimination, by R. S. Hahn. (52—A-41)

A Lathe Test for the Evaluation of Cutting Fluids, by J. D. Oathout, W. C. Howell, Jr., J. P. Hamer, and H. L. Leland. (52—A-49)

Power Required by Carbide-Tipped Face-Milling Cutters, by W. W. Gilbert, O. W. Boston, and H. J. Siekmann. (52—A-53)

Pulverized-Coal Gasification Ruhrgas Processes, by Kurt Traenckner. (52—A-102)

Controlled Internal-Contour Shielded-Root Welds Without Backing Rings, by Charles Diehl, H. S. Blumberg, and W. G. Benz, Jr. (52—A-141)

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—IV, by F. Osterle, A. Charnes, and E. Saibel. (52—A-24)

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—V, by A. Charnes, E. Saibel, and A. S. C. Ying. (52—A-34)

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—VI, by F. Osterle, A. Charnes, and E. Saibel. (52—A-33)

Experiments With Water-Lubricated Tapered-Land Thrust Bearings, by Maurice Levinsohn and N. E. Reynolds, 3rd. (52—A-29)

The Lubrication of Gyroscopes, by J. E. Brophy and J. B. Romans. (52—A-51)

Contribution to the Theory of Oil Whip, by H. Poritsky. (52—A-64)

Contributions to Hydraulic Control—3, by J. F. Blackburn. (52—A-42)

Contributions to Hydraulic Control—4, by J. F. Blackburn. (52—A-43)

Contributions to Hydraulic Control—5, by J. F. Blackburn. (52—A-44)

On the Validity of Assumptions Made in Theories of Plastic Flow for Metals, by Joseph Marin and L. W. Hu. (52—A-80)

Heat Transfer to Molten Lead-Bismuth Eutectic in Turbulent Pipe Flow, by H. A. Johnson, J. P. Hartnett, and W. J. Clabaugh.

ASME 1953 SEMI-ANNUAL MEETING PREPRINTS

Pamphlet copies of the following ASME Semi-Annual Meeting Papers are available from ASME Order Department, 29 West 39th St., New York 18, N. Y.
See page 733 for details

Paper No.	*Title and Author*
	APPLIED MECHANICS
53—SA-2	Temperature Distribution in the Wake of a Heated Sphere, by D. H. BAER, W. G. SCHLINGER, V. J. BERRY, and B. H. SAGE
53—SA-3	Skin Friction and Heat Transfer for Laminar Boundary-Layer Flow With Variable Properties and Variable Free-Stream Velocity, by S. LEVY and R. A. SEBAN
53—SA-4	Constant-Strain Waves in Strings, by J. D. COLE, C. B. DOUGHERTY and J. H. HUTH
53—SA-5	Measurements of Torsional-Stiffness Changes and Instability Due to Tension, Compression, and Bending, by H. L. ENGEL, and J. N. GOODIER
53—SA-6	Flexural-Wave Solutions of Coupled Equations Representing the More Exact Theory of Bending, by JULIUS MIKLOWITZ
53—SA-7	Dynamic Stress-Strain Relations for Annealed 2S Aluminum Under Compression Impact, by J. E. JOHNSON, D. S. WOOD, and D. S. CLARK
53—SA-8	The Measurement of Acceleration Pulses With the Multifrequency Reed Gage, by HENRY SHAPIRO and D. E. HUDSON
53—SA-9	Flexural Vibrations in Uniform Beams According to the Timoshenko Theory, by R. A. ANDERSON
53—SA-10	The Rate of Growth of Vapor Bubbles in Superheated Water, by PAUL DERGARABEDIAN
53—SA-11	On Reinforced Circular Cutouts, by E. LEVIN
53—SA-20	The Effect of Strain Hardening in an Annular Slab, by P. G. HODGE, JR.
53—SA-41	Analysis of a Nonlinear Dynamic Vibration Absorber, by L. A. PIPES
	AVIATION
53—SA-27	Production Capabilities of Large Extrusion Presses and Auxiliary Equipment, by G. E. MONI
53—SA-28	Panel Extrusions in Aircraft Structures, by HOWARD KASTAN
53—SA-31	Air Conditioning the Super Constellation, by B. L. MESSINGER and H. M. COUSINS
53—SA-32	Propulsion Wind Tunnel of the Arnold Engineering Development Center at Tullahoma, Tennessee, by F. L. WATTENDORF, JOHN NOYES, and A. I. PONOMAREFF
53—SA-35	The Use of Stator-Blade Control to Obtain Wide Range of Compressor Performance for Wind-Tunnel Application, by A. W. McCOY and M. J. BRUNNER
53—SA-38	Air-Conditioning Design Features of the DC 7 Airplane, by G. T. ROWE
53—SA-39	Light Alloy Forging Design and Production Problems as Related to Heavy-Press Operations, by A. E. FAYRE
53—SA-52	Design Considerations Associated With Large Aluminum Forgings, by C. W. ANDREWS
53—SA-83	Modernization of the C-46 Airfreighter, by P. W. MILLER
53—SA-84	The Aircraft Economic Parameter and Its Use in the Comparative Evaluation of All-Cargo-Type Aircraft, by G. A. BUSCH

Paper No.	*Title and Author*
	BOILER FEEDWATER STUDIES
53—SA-12	Progress in the Study of Corrosion in the Moisture Region of Large Steam Turbines, by T. W. BIGGER, J. F. QUINLAN, and C. C. CARSON
53—SA-13	Zeolite Versus Soda Ash in Hot-Process Softener at Firestone, by W. F. FIELDS
53—SA-14	Recirculating Cooling-Water System at Tucson, by J. H. SAUNDERS
53—SA-15	Reduction of Condensate-Line Corrosion, by SCOTT JENSEN and E. R. LANG
53—SA-18	The Mitigation of Marine Fouling by Anaerobic Treatment, by H. T. DUPLICE and R. C. ALEXANDER
53—SA-19	A Preliminary Investigation of Iron-Oxide Deposition in Boiler-Feedwater Systems, by E. G. GOTHBERG, H. KEHMNA, and E. S. JOHNSON
53—SA-59	Ion-Exchange Equipment in the Treatment of Boiler Make-Up Water—Experiences During Early Stages of Operation, by A. A. LINGO
	FUELS
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53—SA-30	Offshore Deliveries of Fuel Oil From Tankships Through a Submarine Line to Moss Landing Steam Plant, by S. P. JOHNSON and E. A. SALO
	GAS TURBINE POWER
53—SA-69	Experimental Investigations of Propagating Stall in Axial-Flow Compressors, by T. IURA and W. D. RANNIE
53—SA-70	An Application of the Palouste Turbocompressor, by O. H. JACOBSON and P. VOLKMAR
53—SA-71	Combination Propulsion Plants for Naval Vessels, by J. J. McMULLEN
53—SA-72	Concepts of Efficiency of Weight and Useful Load Relations in Disk Wheels of Aircraft Gas Turbines, by J. S. ALFORD
	HEAT TRANSFER
53—SA-34	A Summary of NACA Research on Heat Transfer and Friction for Air Flowing Through Tube With Large Temperature Difference, by BENJAMIN PINKEL
53—SA-42	Intermittent Heating of Airfoils for Ice Protection Utilizing Hot Air, by H. H. HAUGER, JR.
53—SA-43	Steady-Temperature Fields in Electrical Coils by Membrane Analogy, by P. J. SCHNEIDER and ALI B. CAMBEL
53—SA-44	Remarks on Film Condensation With Turbulent Flow, by A. R. SEBAN
53—SA-45	The Design of Wet Air-to-Air Heat Exchangers, by J. M. APPELGATE
53—SA-46	Forced Convection From Nonisothermal Surfaces, by JOHN KLEIN and MYRON TRIBUS
53—SA-47	Heat Transfer to Constant-Property Laminar Boundary-Layer Wedge-Flows With Stepwise and Arbitrary Wall-Temperature Variation, by STEVE SCESA and SOLOMON LEVY
53—SA-51	Transient Thermal Stresses in Circular Disks and Cylinders, by G. HORVAY

Paper No. — *Title and Author*

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53—SA-50 The Oscar—A New Approach to the Analysis of Oscillographic Records, by B. S. BENSON

53—SA-53 Automatic Calibration of Transducers, by J. F. KINKEL and R. R. MAWSON

53—SA-64 Application of Magnetic Recording to Flight Instrumentation, by M. J. STOLAROFF

LUBRICATION ACTIVITY

53—SA-1 On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—VII. The Nonsteady-State Operation of Tilting-Pad Slider Bearings, by F. OSTERLE, A. CHARNES, and E. SAIBEL

53—SA-36 The Dynamics and Lubrication of a Miniature Turbine Rotor on Porous Bushings, by GEORGE SINES

MACHINE DESIGN

53—SA-62 Methods Used in Investigating Geartooth Loading in the Colmol, by J. A. FLINT

53—SA-63 Twisting of Flexible Shafts, by K. E. BISSHOPP and D. C. DRUCKER

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53—SA-55 The Work-Sampling Technique, by A. J. ROWE

53—SA-56 Cost Reduction Through Electronic Production Control, by R. G. CANNING

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52—SA-21 Machining Integrally Stiffened Structures, by J. C. BORGER

Paper No. — *Title and Author*

53—SA-33 Machining of High-Tensile-Strength Steel, by F. M. RAYBURN

METALS ENGINEERING

53—SA-25 Dynamic Properties of Nodular Cast Iron—Part II, Size Effect, by HARRY MAJORS, JR.

53—SA-26 Mechanical Aspect of Seizing in Metal Wear, by HARRY CZYZEWSKI

PETROLEUM

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53—SA-37 Design of Steam Piping and Valves for 1100 F, by F. A. RITCHINGS and SABIN CROCKER

53—SA-58 Fabrication of Austenitic Stainless-Steel Steam Piping for Operation at 1100 F, by W. G. BENZ and R. H. CAUGHEY

53—SA-65 Features of Nuclear Power Plant of Interest to Power-Plant Engineers and Operators, by R. A. BOWMAN

53—SA-66 Removal of Fireside Deposits Through Use of Mechanical Slag Blowers, by J. A. VANYO and S. F. WALLEZE

53—SA-73 Effect of Exhaust Pressure on the Economy of Condensing Turbines, by A. KELLER and J. E. DOWNS

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53—SA-68 Organization for Production Engineering, by R. H. McCARTHY

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Additional coupon books, each containing ten coupons, are available to members at $2 each; to nonmembers at $4 each.

For further details, see page 733.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Filing Engineering Information

COMMENT BY HADLEY JACOBS[1]

By the design engineer, who is frequently required to have at his fingertips several hundreds of catalogs and advertising brochures, there is another pressing need than those mentioned in the paper.[2] That need is for keeping all publications on filing engineering literature available for quick reference.

All of the trade periodicals now include a numbered page or more on which are listed the most recent products and a post card that makes it a simple matter to request those of the reader's choice. Cataloguing the steady stream of product information which then follows becomes a necessity if any use is to be made of the acquisitions.

After having tried several systems over the past few years which ultimately proved burdensome or incomplete, the writer arrived at the system which follows. It should fill the needs of many engineers who must keep abreast of product development without relying on memory.

The larger catalogs, such as those covering the transmission field as well as several others which bear the manufacturer's name on the binding, customarily are placed on the engineer's shelf or bookcase. This is good practice because these are usually too heavy for a file drawer. However, in many offices, others, which carry the manufacturer's name only on the cover, invariably are placed alongside. Soon it becomes tedious to locate the latter. Then, too, it is almost impossible to maintain a tidy shelf as these publications are prone to slip down under or behind the others.

Instead, the writer arranges alphabetically by manufacturer only the large bound catalogs on shelves. A 3 in. × 5 in. file card made as in Fig. 1, is placed in a file box or drawer which, filed by product, becomes a cross reference.

CONVEYING MACHINERY

* Barber-Greene Company
Continental Gin Company (1941)
Link-Belt Company (1950)
Webb, Jervis B, Company (1951)

* In bookcase

FIG. 1

Each of the brochures, which are by far in the majority, are then filed in standard $8\frac{1}{2}$-in. × 11-in. file drawers also by manufacturer's name. When several different products appear in the same brochure a separate card should be made for each product that one feels important to recall.

Mention should be made of the suspension or "hanging" type of file folder available at stationery supply houses. This style lends itself unusually well to this system.

An earlier attempt was made to file all such material by product listing but this proved complicated by reason of there being more than one product shown in many brochures. Also, too many subject classifications were involved, which resulted in "lost" catalogs. Now, the card index solves this as shown in Fig. 2.

The drawer file material now finds its way from and back into its proper folder where more than one person has access to it. Formerly it was impossible to expect everyone concerned to know the category in which to find, much less return, the material. However, one can much more readily shuffle through a file of cards. Returning by manufacturer listing becomes natural.

One word of caution before starting:

HOISTS (See CRANES & HOISTS)

FIG. 2

People invariably will file all catalogs and brochures with their bindings down. This results in having to leaf through reams of pages instead of flipping the article in entity with the binding up.

[1] Mechanical Engineer, Southern Ferro Alloys, Division of Tennessee Products and Chemical Corporation, Chattanooga, Tenn. Jun. ASME.

[2] "A Suggested Filing System," by G. A. Hawkins and L. M. K. Boelter, MECHANICAL ENGINEERING, vol. 74, August, 1952, pp. 647–648.

Industrial Fires and Explosions

COMMENT BY T. C. GERBER[3]

Under the subheading, "The Dispersion Industry," the author of this paper,[4] makes the following statement: "Of course, the two excluded industrial areas, mines and ordnance plants, are known to be large and gruesome contributors to explosion casualties and losses, probably well overshadowing the aggregate of all other industries in regard to injuries and deaths of personnel." By inference this statement is based upon the record cited on the number of dust explosions in the United States to April 1, 1946, as reported to the NFPA.

The bulk of the munitions production in this country from 1942 to 1946 was processed in government owned-contractor operated ammunition facilities and shows for the period between September, 1944, and June, 1945, the highest rate in tonnage of production attained. During this same period of peak production the accident-frequency rate reached a low range of between 4.0 in September, 1944, and 3.1 in June, 1945. Published figures for this period show but few industries in the country with better records. In fact, the low of 3.1 even exceeded the ladies'-garment industry which uniformly had had the best records of any published. When it is considered that roughly a quarter-

[3] Resident Manager, Liberty Powder Company, Division of Olin Industries, Inc., Newport, Ind. Mem. ASME.

[4] "Industrial Fires and Explosions From Electrostatic Origin," by Robin Beach, MECHANICAL ENGINEERING, vol. 75, April, 1953, pp. 307–313.

million persons were taken from farms and factories, few of them having any experience with explosives, and put into an explosives industry, it is considered remarkable that such a low-frequency rate was obtained.

Having been director of safety for the U. S. Army, Ordnance Department, from 1943 to the end of the war in 1945, and having seen this industry set such a good record in safety, the writer does not feel that ordnance plants should be classed in the safety field at any time with mines.

COMMENT BY JEROME LEDERER[5]

The author should be commended for acting as a rallying point for those who see in electrostatics a continuing and increasing hazard but who have not had the skill to analyze the problem or point out areas for research, study, and control.

In so far as aviation is concerned, the author mentions the diligence and the financial support with which aviation has tried to meet the problems. There has been some success in improving static-discharge protection through the research of the Lightning and Transients Research Institute of Minneapolis; the use of ultrahigh radio frequency has reduced the problem of static in communications. However, the problem will become more serious as more plastics are used for structural purposes. Plastic canopies on certain types of military aircraft already must cause some anxiety. Experiments are under way with plastic molded wings for fighter aircraft; the electrostatic problems that they will present will probably be of considerable magnitude.

At present there is a strong difference of opinion in the aviation industry as to the need for grounding of aircraft and of refueling trucks during refueling operations. One side says that bonding of the truck to the aircraft provides sufficient protection—grounding is unnecessary. The other side says that grounding can do no harm, that grounding is required for other reasons anyway, and therefore the argument is unnecessary. Does the author have any comment on this?

Also, is there danger of electrostatic sparks occurring due to tearing of metal during, say, a crash landing and can such sparks be prevented?

The author refers to the misfiring and stopping of airplane engines by electrostatic charges—has there been any recent scientific proof of this?

Reference also is made to tire blowouts on landing; to baggage and tail-compartment fires and explosions. Are there any proved instances of this?

Failure of navigation instruments as a result of electrostatic charges is mentioned. This also has happened to other types of instruments that depend on magnets for their operation. Does the author have a cure for this?

COMMENT BY E. J. RUTAN[6]

The most important statement in this paper, in the writer's opinion, is the first item of the conclusion: "Electrostatic fire and explosion hazards are all capable of resolution and control to the extent of their virtual elimination." It seems most unfortunate, with such a positive statement in favor of prevention, that there are still fires and explosions whose origin can be traced to electrostatic ignition. This readily leads to the second conclusion that full support of management is required.

There seems to be a feeling in regard to electrostatic hazards similar to the attitude toward communism—it cannot happen here. The value of this paper, therefore, lies in the data which are presented to show the wide range of these hazards and the ease of ignition. This paper should serve as a convenient reference for recognizing the presence of two of the elements in the explosion triangle mentioned by the author.

The determination of the presence of the third element, namely, the ignition factor, according to the author requires knowledge and skill. As stated by the author at the bottom of Table 1, the ignition energy is extremely small, about one-millionth of a Btu or less. To detect the generation of electrostatic energy of this order requires experience in the application of measuring equipment so that indications of false security are not obtained. It is most provocative that electrostatic energy, the simplest to generate, can prove to be the most difficult to measure.

Unless reliable measurements are made of the value and location of these potentials, adequate elimination or nullification cannot be provided. Too often equipment has been installed or protective measures taken and if nothing happens for a while the hazard is considered eliminated. As the author points out, unless measurements are made of the effectiveness of the protection, its reliability cannot be assured.

This is a paper which should be read frequently as a reminder of the hazards which may be overlooked but can be rendered safe.

COMMENT BY PAUL M. WOOD[7]

The author lists three basic components of the explosion triangle. In industry there is more uniformity and routine than in operating rooms where no two surgical procedures are alike. The many additional factors required, all to be at their critical point simultaneously, is one explanation of our relative safety.

Committees on operating-room hazards are functioning throughout the United States. The author is consultant to the New York committee. His statement, "explosions have been occurring with alarming frequency," is too disturbing. True, all anesthetists are striving to achieve a "no-hazard" status. Consider some facts. Flammable anesthetics have been used in ever-increasing numbers since 1846. About 350 fires and explosions were recorded from 1846 to 1938; one out of ten was fatal. Of this number 28 per cent were due to static. With increased knowledge and education, the "avoidable" 72 per cent has been reduced to about 20 per cent. In 1938, records indicate about 3,000,000 anesthetic administrations; in 1951, 10,000,000 per year, more than half using flammable agents. In 1952 George Thomas indicated that death from static hazard is about 1:1,500,000 administrations. This is too many, but it seems unfair to arouse patients' fears by so vigorous a statement as "explosions have been occurring with alarming frequency." We do seek help to eliminate those which do occur.

AUTHOR'S CLOSURE

The author is particularly gratified by the general interest shown in his paper, both by those who presented written comments and the many others who offered comments or asked questions during and after the session.

Mr. Lederer not only suggested many germane and provocative possibilities for the generation of static electricity on modern ultrahigh speed airplanes but also propounded several questions which he directed to the author.

Some of these questions are considered in "What of Air Safety?" by Robin Beach, published in the May, 1948, issue of *Electrical Engineering* and also in Bulletin 14, January, 1948, of the NFPA Committee on Aviation and Airport Fire Protection on which committee the writer served as consultant.

The bonding of refueling trucks to airplanes only serves to equalize their individual potentials. This bonded system, however, when insulated from ground as it is by dry concrete, may possess a high

[5] President, Flight Safety Foundation, Inc., New York, N. Y. Mem. ASME.

[6] American Cyanamid Company, New York, N. Y.

[7] Anesthesiologist, 131 Riverside Drive, New York, N. Y.

and dangerous potential above ground which can arise from cloud induction or from blowing dust. This potential spark and fire hazard during refueling can be eliminated only by thorough grounding of the bonded system.

Electrostatic ignitions during crash landings doubtless occur from sparks generated by contact potential developed between the moving airplane and insulating surfaces, such as dry concrete strips or desert sand. Percussion sparks from crash landings also add potential ignition hazards. No practical means of control seem apparent from either type of spark ignition other than to "keep 'em flying."

On the highways through the Southwestern deserts, it is common experience for automobile engines to be incapacitated by misfiring from electrostatic sparks caused by high electrification of the vehicles from blowing sand. Energy releases as high-potential currents from induced electrification on airplanes during distant lightning strokes can also affect the ignition sequence of engines, especially in the common instances of imperfect harness on ignition wiring. Several such engine failures have been brought to the author's attention.

Tire blowouts on landing and baggage-compartment fires from electrostatic causes are explained with illustrations in "What of Air Safety?", pp. 427–429. The holocaust of the airplane and occupants during a crash landing on Mt. Carmel, Pa., June 17, 1948, resulted from asphyxiation of the pilots by noxious gases from a fire which occurred in the forward baggage compartment.

No instruments are immune to aberrations or failures from normal or accelerated deterioration. However, when instruments which are susceptible to electrostatic field disturbances repeatedly fail at times of high electrification on the airplanes, the cause of their failures seems clearly indicated. The obvious cure of these electrostatic problems on navigational instruments, as well as the cure of accelerated deterioration of tires and of fires or explosions within baggage compartments, wing and tail structures, and compartments of the fuselage, is the control of static electricity on airplanes.

In this connection the currently used antistatic wicks, developed by the Army and Navy Air Forces during World War II, fail to provide effective or continued electrostatic control on airplanes. Of those few commercial airlines which still use them, the wicks seem to be displayed more as tokens of safety to allay fears of the riding public than for their alleged electrostatic control value. Pilots on commercial airlines seem generally agreed that antistatic wicks fail to discharge airplanes.

ROBIN BEACH.[8]

[8] Robin Beach Engineers Associated, Brooklyn, N. Y.

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ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

Books Received in Library

ASTM-IP PETROLEUM MEASUREMENT TABLES. Prepared jointly by American Society for Testing Materials and The Institute of Petroleum. American Society for Testing Materials, Philadelphia, Pa. American edition, 1953. 525 p., 10 × 7¼ in., bound. $8.75. This internationally developed publication provides tables covering normal operating ranges for the reduction of gravity and volume to standard temperature, for calculation of weight-volume relationship, and for interconversion of a wide variety of commercially useful units. The tables are applicable both to crude petroleum and finished petroleum products. The American edition includes tables applicable to U. S. units of measurement; similar volumes have been issued with respect to British units and metric units.

ANNUAL REVIEW OF NUCLEAR SCIENCE. Volume 2, 1953. Annual Reviews, Inc., Stanford, Calif., 1953. 429 p., 9 × 6¼ in., bound. $6. The sixteen papers contained in this volume cover a considerable range of topics, including the following: origin and distribution of the elements, production and distribution of natural radiocarbon, recent progress in accelerators, nuclear and photonuclear reactions, subnuclear particles, radiation effects in solids, isotopes, nuclear moments, cosmic rays, and high-energy fission.

BEHAVIOR OF METALS AT LOW TEMPERATURES. By R. M. Brick, J. R. Low, Jr., and C. H. Lorig. American Society for Metals, Cleveland, Ohio 1953. 112 p., 9¼ × 6¼ in., bound. $3. Three lectures are reprinted in this volume: behavior of single crystals and of pure metals, dealing primarily with mechanical properties and basic related phenomena; the influence of mechanical variables, considering the effect of stress-state, rate of loading, etc., on strength and ductility; influence of metallurgical factors, mainly concerned with ductility and brittle-fracture susceptibility.

DIAGRAMMES ENTHALPIE-ENTROPIE. By P. Chambadal. Dunod Editeurs, Paris, France, 1953. 50 p., 10⅝ × 8⅝ in., paper. 940 F. fr. Three large, detailed enthalpy-entropy charts for air and combustion gas are provided, chiefly for use in connection with gas-turbine design. A supplementary pamphlet explains their use, gives a brief introduction to gas-turbine theory, and discusses the thermodynamic properties of gases and gas mixtures.

ELEMENTS OF INTERNAL-COMBUSTION ENGINES. By A. R. Rogowski. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 205 p., 9¼ × 6¼ in., bound. $5.50. Intended for the non-specialist engineering student, this text provides a broad coverage of engine practice from the basic principles to performance efficiency and supercharging. Emphasis has been placed on the application of elementary principles of physics, chemistry, mechanics, etc., to the specific engineering problems connected with estimating and obtaining the maximum power, efficiency, and reliability from the internal-combustion engine.

ENGINEERS AS WRITERS. Edited by Walter J. Miller and Leo E. A. Saidla. D. Van Nostrand Company, Inc., New York, N. Y., 1953. 340 p., 8¾ × 5¾ in., bound. $4.25. A text for instruction in technical composition, presenting selections from the works of fifteen engineering writers of different periods and fields. Each selection is followed by a critical analysis, suggestions for study, and topics for oral or written reports. The selections—running from Vitruvius and Agricola to Taylor and Hoover—are, for the most part, suitable for students in any field of engineering, and readily understandable to the layman. A few highly specialized writings are included.

FLUID DYNAMICS. (Proceedings of Symposia in Applied Mathematics, volume 4) American Mathematical Society. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 186 p., 10¼ × 7 in., bound. $7. Fourteen papers by recognized authorities are presented which provide among other topics, significant contributions on the statistical theory of turbulence and the mathematical theory of supersonic and transonic flow. The subject of incompressible flow is represented by articles on propeller theory, numerical methods, viscous flow, and the method of singularities. There are also treatments of shock waves and gravity waves.

GASES IN METALS. By D. P. Smith, L. W. Eastwood, D. J. Carney and C. E. Sims. American Society for Metals, Cleveland, Ohio, 1953. 204 p., 9¼ × 6¼ in., bound. $3. The four lectures reprinted in this volume deal respectively with the following topics: fundamental metallurgical and thermodynamic principles of gas-metal behavior; gases in nonferrous metals and alloys; gases in liquid iron and steel; behavior of gases in solid iron and steel. There is a bibliography with each article.

GREEN LEAF GUIDE. National Reference Guide for the Patent Field. Field Publications, Port Washington, N. Y., 1953 edition. 64 p., 9 × 6 in., paper. $2. This guide contains broadly classified listings of leading manufacturers in every important industrial field and companies which are actively seeking new ideas of many different kinds. It also contains a brief list of services for inventors and patent attorneys and notes on government publications relating to patents.

HIGH-SPEED INTERNAL-COMBUSTION ENGINE. By Harry R. Ricardo. Blackie & Son Ltd., Glasgow, Scotland (distributed in U. S. by Autobooks, Burbank, Calif.) fourth edition, 1953. 420 p., 9¼ × 6½ in., bound. $11. In this standard work, now completely re-

written, the author draws extensively from the research, design, and development work carried out in his firm's laboratory. While emphasizing the less well-known aspects of the subject he deals clearly and concisely with all major topics: detonation and pre-ignition; latent heat and heat distribution; combustion-chamber design; mechanical efficiency; supercharging; cylinders and pistons; mechanical design and the major engine types. No attempt is made to deal with the gas turbine.

HISTORY OF STRENGTH OF MATERIALS. By Stephen P. Timoshenko. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 452 p., $9^1/_4 \times 6^1/_4$ in., bound. $10. Based on Professor Timoshenko's lectures on engineering mechanics, this book traces the development of the science of strength of materials from Archimedes to the present. Brief biographies of workers in the field are included; and the relation of progress in the science to industrial development and engineering education is considered. Some discussion of the history of the theory of elasticity and the theory of structures is also included.

INDUSTRIAL WASTES. (American Chemical Society Monograph Series, No. 118) Edited by Willem Rudolfs. Reinhold Publishing Corporation, New York, N. Y., 1953, 497 p., $9^1/_4 \times 6^1/_4$ in., bound. $9.50. This monograph discusses the waste-treatment problem in general, principles of stream pollution and self-purification, and disposal problems of the following industries: food processing; tanning, fat processing, and laundry soap; textile dyeing and finishing; pulp and paper; acids and explosives; steel pickling; plating; coal mining. Also considered are water-disposal problems of the petroleum industry and treatment of liquid radioactive wastes. References are given at the end of each chapter.

INTRODUCTION TO THE THEORY OF PLASTICITY FOR ENGINEERS. By Oscar Hoffman and George Sachs. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 276 p., $9^1/_4 \times 6^1/_4$ in., bound. $6.50. This text deals with that comparatively recent branch of mechanics which treats the behavior of ductile metals beyond the elastic range. It not only introduces the fundamentals, but also gives accounts of all major engineering applications of the theory of plasticity. The several sections are as follows: basic laws and theories; problems in plastic flow of ideally plastic materials; plastic flow of strain-hardening materials; theory of metal-forming processes.

KINEMATICS OF MECHANISMS. By N. Rosenauer and A. H. Willis. Associated General Publications, Sydney, Australia, 1953. 395 p., $8^3/_4 \times 5^3/_4$ in., bound. £ (Aust.) 4.105. Od. The primary emphasis in this textbook is on the analysis of existing mechanisms. Among the topics discussed are kinematic chains and pairs; methods for determination of the center of curvature of the path of a point; and general methods of velocity and acceleration analysis. The concluding chapter serves as an introduction to the design of mechanisms by rational methods. Throughout the book, graphical methods are used rather than analytical solutions.

KURZES HANDBUCH DER BRENNSTOFF-UND FEUERUNGSTECHNIK. By Wilhelm Gumz. Springer-Verlag, Berlin, Germany, second edition, 1953. 583 p., $9^1/_4 \times 6^3/_4$ in., bound. 45 Dm. This manual on fuels and combustion is intended as a guide for the combustion engineer for planning, design, or supervision. It presents in concise form the fundamentals of combustion reactions with the necessary calculations and discusses gas producers. Special topics include flow conditions in fluidized fuel, flow resistance through granular beds, incomplete combustion, gasification calculations, and gas-generator firing.

MACRAE'S BLUE BOOK, sixtieth edition, 1953. MacRae's Blue Book Company, Chicago, Ill., 1953. 4127 p., $11 \times 8^1/_2$ in., bound. $15. This sixtieth annual edition of one of the standard directories of American manufacturers and their products follows the arrangement of previous editions; a list of industrial manufacturers and their distributors; a detailed classified materials section with cross-references; and a trade-name index. Capital ratings are indicated where reliable information has been supplied.

MANUAL ON INDUSTRIAL WATER. (Special Technical Publication No. 148) American Society for Testing Materials, Philadelphia, Pa., 1953. 336 p., $9^1/_4 \times 6^1/_4$ in., bound. $4.25. Primarily a reference manual for those engaged in industrial operations using water, this book is also suitable for classroom use. It discusses uses of water and problems of supply; composition, sampling, and analysis of industrial water; water-formed deposits; and the reaction and corrosion products of water. The appendix contains all ASTM water standards and test methods.

MECHANICAL INSPECTION. By W. H. Armstrong. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 361 p., $9^1/_4 \times 6^1/_4$ in., bound. $5.50. This textbook is designed for use in technical institutes and in training inspectors for machine shops and related industries. It includes material on blueprint reading; a survey of precision and non-precision tools for dimensional inspection; instruction in the use and care of instruments; and an explanation of the mathematics of inspection. Some aspects of hardness testing, magnaflux and radiographic inspection, and statistical quality control are also discussed.

MECHANICAL POWER TRANSMISSION MANUAL. By William A. Williams. Conover-Mast Publications, Inc., New York, N. Y., 1953. 423 p., $8^1/_4 \times 6$ in., bound. $6. This manual covers briefly but adequately the fundamentals of acceleration, power, and work governing the selection of proper power-transmission equipment. It outlines the principles on which each piece of mechanical power-transmission equipment functions, its performance characteristics, its advantages, and the types of drives to which it is best adapted.

METAL CLEANING BIBLIOGRAPHICAL ABSTRACTS, 1842–1951. (Special Technical Publication, No. 90-B). By Jay C. Harris. American Society for Testing Materials, Philadelphia, Pa., 1953. 132 p., 9×6 in., paper. $4.25. The new edition of this extensive bibliography combines all references from the 1949 edition, the 1950 supplement, and several hundred new ones. The coverage includes all kinds of metal and most types of processes. The arrangement is chronological by years, and alphabetically by author within each year. In addition to subject and author indexes there are also specification and patent indexes.

PHYSICAL FORMULAE. By T. S. E. Thomas. John Wiley & Sons Inc., New York, N. Y., 1953. 118 p., $6^3/_4 \times 4^1/_2$ in., bound. $2. Intended as a reference book for physicists and engineers, this is a compilation of the principal mathematical laws and formulas arranged in the following subdivisions: mathematics and statistics; mechanics; hydraulics; elasticity; general physics; accoustics and Fourier series; heat; light; electricity and magnetism; and electronic physics. Purely empirical formulas, and those of little practical importance have been omitted.

POMPES, VENTILATEURS, COMPRESSEURS. By A. de Kováts and G. Desmur. Dunod, Paris, France, 1953. 336 p., $9^1/_2 \times 6^1/_2$ in., bound. 3800 F.fr. Beginning with an elementary discussion of turbomachines and fluid flow, this treatise continues with detailed considerations of the design and construction of pumps, blowers, and compressors, both centrifugal and axial. The mechanical and hydraulic aspects of impellers, casings, and other elements are analyzed; detailed calculations are carried out with practical examples; and brief comment is made on special pump types, selection of equipment, and test methods.

PRINCIPLES OF HEAT TREATMENT. By M. A. Grossmann. American Society for Metals, Cleveland, Ohio, 1953. 303 p., $9^1/_4 \times 6^1/_4$ in., bound. $5. A revised edition of an original series of lectures covering principles of hardening, hardenability and quenching, transformations during cooling, normalizing and annealing, surface-hardening processes, grain-size considerations, and the determination of transformation diagrams. The author has emphasized fundamentals and has used a clear, logical presentation for the benefit of readers with little previous experience.

REFRACTORY HARD METALS. By Dr. Paul Schwarzkopf and Dr. Richard Kieffer. The Macmillan Company, New York, N. Y., 1953. 447 p., $9^1/_2 \times 6^1/_2$ in., bound. $10. This volume deals with the structure, preparation, and properties of the pure carbides, borides, nitrides, and silicides. An introductory section discusses the history of hard metals and their crystal and electronic structures. Separate sections are devoted to each of the materials under consideration, and a final section discusses their use as high-temperature materials. Bibliographical footnotes are included. Cemented carbides will be treated in a subsequent volume.

SCIENCE OF PETROLEUM. Volume 5, Part 2: SYNTHETIC PRODUCTS OF PETROLEUM. Edited by B. T. Brooks and A. E. Dunstan. 329 p. $35. Volume 6, Part 1: THE WORLD'S OILFIELDS. The Eastern Hemisphere. Edited by V. C. Illing. 174 p., $35. Oxford University Press, New York, N. Y., 1953. $11^1/_4 \times 8^1/_2$ in., bound. In 1937 the first four volumes of this standard reference work were published, constituting a comprehensive treatment of the full range of petroleum technology. The subsequent volumes, although continuing the volume numbering, are supplementary in nature. The contributions in vol. 5, part 2, on synthetic products, and refinery processes fall into two classes: those which deal with subjects and processes new since 1937, and those which bring up to date the subjects originally covered in the earlier volumes. Vol. 6, part 1, represents the first section to be prepared in the revision of vol. 1, and contains authoritative geological descriptions of the more important oil-producing areas in Europe, the Middle East, Africa, the Far East, and Australasia.

TOOL ENGINEERS' DATA BOOK. By Gerhard J. Gruen. Reinhold Publishing Corporation, New York, N. Y., 1953. 219 p., $9^1/_4 \times 6^1/_4$ in., bound. $5.50. A compilation of tables, specifications, formulas, and constants for the practicing tool engineer, containing a minimum of explanation. It includes standard specifications; tables of the physical constants, the chemical, physical, working properties, and weights of metals and alloys; tables of the general properties of special alloys and plastics, data for rapid identification of metals, alloys,

and plastics; and other pertinent data. A glossary of metallurgical terms is also given.

TRAGFAHIGKEIT METALLISCHER BAUKORPER IN BAUTECHNIK UND MASCHINENBAU. By Karl Helmut Rühl. Wilhelm Ernst & Sohn, Berlin, Germany, 1952. 184 p., 9 1/2 × 6 3/4 in., paper. 24 Dm. A review of the theory and research work on the load capacity of metal structures in both civil and mechanical engineering, covering steel and light metals. It summarizes present knowledge concerning stress distribution in structures, residual stresses, yield, plasticity, embrittlement, structural strength under alternating load, impact and shock effects, and the transmission of safe loads.

WERKSTOFFE FUR GLEITLAGER. Edited by R. Kühnel. Springer-Verlag, Berlin, Germany, second edition, 1952. 454 p., 9 1/4 × 6 1/2 in., bound. 69 Dm. This treatise on bearing materials is divided into three sections: Part 1 covers the testing and evaluation of bearing materials; part 2 deals with metallic materials, and this edition now contains chapters on silver and cast-iron bearings; part 3 is devoted to nonmetallics—natural wood, pressedwood, plastics, etc. Each chapter covers generalities, composition, properties, and test results, both in the laboratory and in practice.

WRITINGS OF THE GILBRETHS. Edited by William R. Spriegel and Clark E. Myers. Richard D. Irwin, Inc., Homewood, Ill., 1953. 513 p., 9 1/4 × 6 1/4 in., bound. 37.35. This book assembles in a single volume the works of Frank B. and Lillian M. Gilbreth, edited to include evidences of lasting principles and problems, to exclude matter significant only at the time of writing, and to avoid duplication of the works of their contemporaries. The original wording has been retained except for minor changes in spelling and terminology, and changes made in the interest of continuity and readability. The volume includes a combined index to the writings.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting June 26, 1953, and approved by the Board on August 11, 1953.)

CASE NO. 1118–2 (REOPENED)

Inquiry: Is it permissible to use forgings conforming to Specification SA-350-52T in the construction of unfired pressure vessels under the requirements of Section VIII of the Code? The forgings are intended for use at low temperatures.

Reply: It is the opinion of the Committee that it is permissible to construct unfired pressure vessels of the material specified in the inquiry under the requirements of Section VIII of the Code with the following additional provisions:

(1) The service temperature shall not exceed 650 F.

(2) The allowable stress-value shall be 15,000 psi for Grade LF-1 and 17,500 psi for Grade LF-3.

(3) For qualification under Section IX Grade LF-1 shall be placed under P-Number 1 and Grade LF-3 shall be placed under P-Number 5 of Table Q-11.1.

CASE NO. 1167

(Special Ruling)

Inquiry: Appendix Q of Par. UA-601 outlines the basis upon which stress values are established for nonferrous materials. SB-96 (Plate and Sheet) has physical properties justifying a stress above the 10,000 psi shown in Table UNF-23 in the "Subzero to 150" temperature range. What stress value may be used?

Reply: Since SB-96 (Plate and Sheet) has a minimum yield strength of 18,000 psi, and since this figure provides the limiting stress value, two thirds of 18,000 psi, or 12,000 psi, may be used instead of the 10,000 psi now shown in Table UNF-23 for the "Subzero to 150" temperature range.

CASE NO. 1168

(Special Ruling)

Inquiry: The thickness of formed heads having pressure on the convex side required by Par. UCS-33 and for spherically dished cover plates by Par. UA-6(c) of the 1952 Edition of Section VIII is considerably heavier in certain thickness and temperature ranges than was required by the rules in the 1950 Edition and Case No. 1157. Will it be permissible to use the 1950 Code rules and Case No. 1157 as an alternate to the rules in the 1952 Edition for vessels designed to the 1952 Edition?

Reply: The Committee was aware that in changing to the chart-type solution used in the 1952 Edition some differences from past practice would result. The Committee is giving these differences further study. Pending the result of this study it is the opinion of the Committee that for construction conforming to the 1952 Edition of Section VIII it will be a permissible alternate to use the rules of the 1950 Edition of Section VIII, including Case No. 1157, for formed heads and spherically dished cover plates having pressure on the convex side when constructed of ferritic materials.

CASE NO. 1169

(Special Ruling)

Inquiry: May cold-drawn rounds conforming to SB-164, Class A, material in sizes between 1/2 in. and 3 in. be used for bolting material in Code Construction?

Reply: It is the opinion of the Committee that cold-drawn rounds conforming to SB-164, Class A, in sizes between 1/2 in. and 3 in. in diameter may be used for bolting material, if the minimum tensile strength is 90,000 psi, yield strength 70,000 psi, and the elongation is 17 per cent. Allowable design stresses for this material when used for bolting shall be as follows:

Temperature	Subzero to 80 F	200 F
Stress	14,000 psi	13,000 psi

CASE NO. 1170

Inquiry: The formula for tube thickness in Par. P-22(a) requires an added thickness of 0.04 in. ("*e*" in formula) for tubes expanded into tube seats. Experience and tests prove that above certain minimum thicknesses this added thickness is not needed for mechanical strength or tightness of joint. May the minimum thickness of tubes or nipples for expanding into the tube seats in water-tube boilers, economizers, and superheaters be calculated from the formula in Par. P-22(a) with "*e*" equal to zero, the same as for tubes attached by strength-welding, provided the thickness at the ends of the tubes to be expanded is made a minimum of:

- 0.095 in. for tubes 1 1/4 in. O.D.
- 0.105 in. for tubes more than 1 1/4 in. O.D., and up to 2 in. O.D. inclusive
- 0.120 in. for tubes more than 2 in. O.D., and up to 3 in. O.D. inclusive
- 0.135 in. for tubes more than 3 in. O.D., and up to 4 in. O.D. inclusive
- 0.150 in. for tubes more than 4 in.

O.D., and up to 5 in. O.D. inclusive?

Reply: It is the opinion of the Committee that the formula in Par. P-22(a) may be used with "e" equal to zero for such tubes, provided the thicknesses at the ends to be expanded are not less than the minimums stated in the inquiry. Tube ends of lesser thicknesses, to be expanded into tube seats, shall comply with the formula in Par. P-22(a) using "e" equal to 0.040 in.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Material Specifications, 1949

EDITORIAL NOTE

The Boiler Code Committee has approved adding to Section II the following stress values for SA-268-47, Grades TP405, TP410, and TP430, to Table UHA-23.

STRESS VALUES FOR TABLE UHA-23

Mat'l & Spec. No.	Grade	Type	Nom. Comp.	Spec. Min. Tensile	Notes	For Metal Temperatures Not Exceeding Deg F: —20 to 100	200	300	400	500	600
PIPES & TUBES											
Seamless											
SA-268	TP405	...	12Cr-Al	60000	...	15000	15000	14700	14400	13950	13400
SA-268	TP410	...	13Cr	60000	...	15000	14450	14000	13500	13100	12850
SA-268	TP430	...	16Cr	60000	...	15000	15000	14100	13400	13000	12500
Welded											
SA-268	TP405	...	12Cr-Al	60000	(4)	12750	12750	12500	12250	11900	11400
SA-268	TP410	...	13Cr	60000	(4)	12750	12300	11900	11500	11150	10900
SA-268	TP430	...	16Cr	60000	(4)	12750	12750	12000	11400	11050	10650

For Metal Temperatures Not Exceeding Deg F: 650	700	750	800	850	900	950	1000	1050	1100	1150	1200
13000	12450	11800	11000	10100	9100	8000	4000	...	...	...	...
12700	12500	12250	11950	11600	11000	8800	6400	4400	2900	1750	1000
12200	11850	11500	11100	10600	10000	9200	6500	4500	3200	2400	1750
11050	10600	10000	9350	8600	7750	6800	3400	...	...	...	...
10800	10650	10400	10150	9850	9350	7500	5450	3750	2450	1500	850
10400	10100	9800	9450	9000	8500	7900	5500	3800	2700	2050	1500

Low-Pressure Heating Boilers, 1949

PAR. H-4 Revise to read:

H-4 The maximum allowable working pressure on the shell or drum of steel-plate steam heating and hot-water boilers shall be determined in accordance with the following formulas. In no case shall a boiler be designed for a pressure less than 30 psi.

$$P = \frac{SEt}{R + 0.6t} \quad \text{or} \quad t = \frac{PR}{SE - 0.6P}$$

where P = maximum allowable working pressure, pounds per square inch,
S = 20 per cent of the minimum ultimate tensile strength stamped on the shell plate,
t = minimum thickness of shell plates in weakest course, inches,
E = efficiency of longitudinal joint or of ligament between tube holes (whichever is the least),
R = inside radius of weakest course of the shell or drum, inches.

PARS. H-44(a) and H-97(a) Revise the first sentence to read: Each hot-water heating or hot-water supply boiler shall have one or more officially rated relief valves of the spring-loaded type, without disk guides on the pressure side of the valve.

Delete the last sentence in these two paragraphs.

PAR. H-68(a) Revise to read:

H-68(a) The manufacture of welded boilers to be marked with the Code H-Symbol shall construct the boilers according to the requirements of this Code. Inspection shall be made by an authorized inspector. The inspection procedure by which the inspector assures himself that the manufacturer is complying with all the requirements of the code is the responsibility of the authorized inspector.

The inspector shall make such inspections as he believes are needed to enable him to certify that the boilers have been constructed in accordance with the Code. The authorized inspector shall be a state inspector, a municipal inspector, or an inspector employed regularly by an insurance company. This inspector shall have been qualified by written examination under the rules of any state which has adopted the Code.

PAR. H-70 Revise to read:

H-70 Steel-plate boilers constructed by fusion welding under the rules prescribed for steel-plate heating boilers may be used for steam heating at pressures not exceeding 15 psi, for hot-water heating at pressures not exceeding 160 psi or for temperatures not exceeding 250 F. For pressures in excess of 30 psi for hot-water boilers the efficiency of the welded joint (to be used in applying the formulas in Par. H-4) shall be 72 per cent for double welded butt joints or for single welded butt joints with backing strips or 63 per cent for single welded butt joints without backing strips. In determining the pitch of staybolts, fusion-welded joints may be considered as fully supported except when the joint occurs in a flat surface.

Unfired Pressure Vessels, 1952

PAR. UCS-66(d) (2) Revise to read:

(2) No impact tests are required in the construction of pressure vessels of carbon and low-alloy steels for use at temperatures below —20 F, provided the pressure to which the vessel is subjected in service is solely a function of the saturation pressure-temperature relationship of the contents of the vessel, and only when this relationship is such that the pressure at —20 F is not greater than one-fifth the maximum allowable working pressure for which the vessel is designed. In no case shall the design working pressure of the vessel be less than the pressure corresponding to 100 F at saturation. In any other vessel, or in a multiple-compartment vessel, such as a heat exchanger, those parts of the vessel also subjected to temperatures below —20 F wherein the pressures are not controlled solely by the saturation pressure-temperature relationship as thus defined are not exempt from the impact test requirement. This revision expresses the original intent of Par. UG-66 (d)(2) of the 1950 Sec. VIII.

ASME NEWS

With Notes on the Engineering Profession

Eighth ASME Petroleum Mechanical-Engineering Conference Program Announced, Houston, Texas, Sept. 27–30

O. L. Lewis Tells History and Functions of Petroleum Division

At th Petroleum Luncheon held during the 1953 ASME Semi-Annual Meeting in Los Angeles, Calif., O. L. Lewis, Mem. ASME, senior engineer, C. F. Braun Company, Alhambra, Calif., related the following background information which is in fact the history of the development of the Petroleum Division of The American Society of Mechanical Engineers.

Scope of Interest

"The petroleum industry is widespread. The interest covers drilling, producing, transportation, refining, and marketing as carried on by operating companies. There are contractors in drilling, pipe line, plant construction, and process-development work. The equipment manufacturers and suppliers furnish materials to both the operating companies and the contractors. Scientists, colleges, and research centers aid in development. We see that a complete cross section of engineering is found in the petroleum industry.

"No one organization can hope to co-ordinate all this activity or to hold the interest of all engineers engaged in the petroleum industry. The Petroleum Division of ASME is an attempt to provide a common meeting ground for those engineers working with the mechanical-design phases of the industry.

"The petroleum industry is one of the fastest growing in the American economy. Every phase of it is highly competitive. Engineers in this industry must do everything possible to keep up with the rapid rate of growth. Participation in Petroleum Division activity is one way of keeping abreast of new developments, and it is a way that the individual can contribute to the general fund of industry knowledge.

Petroleum Division History

"The first Petroleum Division activity of ASME was organized in 1922. A group of people in the mid-continent area sponsored that activity. This Division then developed into the Mid-Continent Section of ASME. In 1926, there was again a concentrated interest in petroleum activities and a new division was formed. Due to several factors in its organization, that division became inactive in 1940.

"The Petroleum Division as it is known now was organized in 1945. It started at that time as a committee under the Process Industries Division. The first Petroleum Mechanical-Engineering Conference sponsored by this group was held in Tulsa, Okla., in October, 1946. Some 35 technical papers were presented during a three-day meeting. About 200 engineers were registered. In 1949, the Petroleum Committee was granted full division status. Last year, the conference was held in Kansas City, Mo., with approximately 400 in attendance.

This year, the eighth of these annual Petroleum Mechanical Conferences will be held in Houston, Texas, Sept. 27–30. The Houston group are planning for an attendance of 600 to 700.

How Division Was Organized

"When this Division was organized in 1945, an effort was made to avoid the factors that had led to the discontinuance of the previous Petroleum Division. The objectives set out were: (1) To promote and exchange information pertaining to mechanical problems involved in production, transportation, and refining of petroleum and its products. (2) To provide a common meeting ground where mechanical engineers may gather and exchange experience and technical data to the benefit of the individual and the industry. (3) To encourage research and development, and to publish available data in the field. (4) To direct attention to and to recognize outstanding achievements in mechanical engineering in the petroleum industry. The Division was organized to give recognition to each geographic area and to each branch of the industry. Committees are set up sponsoring specific activity in each of the following fields: Refining, production, transportation, materials, and manufacturing. Special committees dealing with student activity, industry research, and publicity also function. Each of the operating committee chairmen has an equal voice in the management of the Division. So far as possible, nominees for these leaders are selected on a geographic basis as well as on their position in the industry. This organization works to accomplish the objectives set out in the by-laws.

Papers Selected

"The papers that are sponsored by the Division may come from several sources. Any paper of petroleum interest sent in to ASME headquarters is referred to this Division. Some papers are sent directly to the Petroleum Division for consideration. When interest has been evidenced in a specific subject, the Division solicits papers covering the various phases of that subject in order to bring it before the membership. The Division also solicits some papers on less generally known subjects in order to build interest in a specific field. The papers presented may be representative of individuals, companies, industry, or government.

Individual Participation

"Occasionally, we have questions asking how an individual can participate in the activities of the Division. These are the ways that we suggest. Work with your local section and see that subjects of interest to your industry are incorporated in their program. Suggest to the Division officers subjects for discussion or research. Suggest authors or authorities with information of interest to the group. Prepare papers for presentation, or prepare a discussion of other papers to be presented. Attend the conferences and committee meetings of the Division."

Petroleum Mechanical-Engineering Conference

The Eighth Petroleum Mechanical-Engineering Conference of the ASME Petroleum Division this year is at the Rice Hotel, Houston, Texas, from September 27 to September 30.

Technical Sessions

Thirty-six papers covering the latest developments in the petroleum industry will be presented in 18 technical sessions. The program features an Unfired Vessel Code Forum and panel discussion of the code and its applications. Representatives of manufacturers, operators, and the code committee will discuss and answer questions. The sessions devoted to specific developments include a refining session

covering mechanical-design features of three new refining processes; hot-tapping and branch reinforcement of piping; latest developments in compressors and drivers; power transmission by friction, fluid, and electromagnetism; drilling and pumping equipment, microwaves and isotopes in pipe-line control; alloys and special materials used in refining, drilling, and production. The proposed pipe-line welding standard will be discussed during the materials and methods session as well as Monel protection for off-shore structures. Other sessions will cover such pertinent topics as casing designs, drilling research, equipment, instruments and methods, inspection, and materials.

Luncheons

Roy Hofheinz, Mayor of the City of Houston, will welcome the guests to the city on behalf of the members of the Division at a luncheon scheduled for Monday, September 28. Highlighting this social function will be a talk by F. S. Blackall, jr., ASME President, who will speak on "The New Challenge to American Industry." On Tuesday, September 29, there will be five special industry luncheons—Refining, Pipe Line, Production and Drilling, Materials, Manufacturing—to give every one an opportunity to lunch with others engaged in a common field of interest and to meet the working committee in each of these particular branches of the industry.

Banquet

Lieut. Gen. Ernest O. Thompson, chairman, Texas Railroad Commission, in his address to the banquet will talk on "Hemispheric Solidarity in Oil." Prof. E. N. Kemler, chairman, Petroleum Division, will present the Student Award and L. S. Wrightsman, chairman, Houston Arrangements Committee, will preside. On Monday, Sept. 28, there will be a dinner and entertainment following the Toast-to-Texas Party.

Inspection Trips

The inspection trips have been arranged to include a boat trip down the Houston Ship Channel to see channel operations, and the industrial area; the Schlumberger Well Survey Corporation's production shops and laboratories; large-diameter pipe-rolling mill operated by A. O. Smith Corporation of Texas; Camron Iron Works, Hughes Tool Company, The Texas, Houston, and Humble Pipe Line Companies; Rice Institute and the University of Houston Laboratories; and the Shell Refinery.

Women's Program

The program planned for the women who will attend the conference should prove entertaining and enjoyable. A sight-seeing tour is scheduled to include the Texas Medical Center, the internationally famous Shamrock Hotel, Rice Institute, an opportunity to see some of the unusual and beautiful gardens (especially if they have had some rain lately), and luncheon at the River Oaks Country Club. The Houston Ship Channel trip is also available to the women. In the evening the festivities start with the Toast-to-Texas Party followed by dinner, entertainment, and dancing in the Crystal Ball Room. A high spot of the program is a Sherry Party to be held at the beautiful new Petroleum Club; later in the evening, the banquet. The trip to the impressive San Jacinto Monument would be indeed worthwhile, it is a rather long drive out, but it could be arranged. The San Jacinto Inn is an ideal spot to have luncheon and rest before the return trip to the city via the Old Spanish Trail.

Registration

THE ASME Registration Desk will be located on the Mezzanine Floor of the Rice Hotel and will be open during the following hours:

Sunday, Sept. 27—3:00 p.m. to 5:00 p.m.

Monday, Sept. 28—8:00 a.m. to 6:00 p.m.

Tuesday, Sept. 29—8:00 a.m. to 6:00 p.m.

Wednesday, Sept. 30—8:00 a.m. to 2:30 p.m.

The Ninth Annual Conference of the ASME Petroleum Division will be held at the Hotel Statler, Los Angeles, Calif., Sept. 26–29, 1954.

The technical program follows:

MONDAY, SEPTEMBER 28

9:00 a.m.

Session (1)—Casing Design

Effect of High-Strength Casing and Casing Joints on Design of Casing Strings, by *Sheldon H. Reynolds*, U. S. Steel Corp.

The Triangulation Method for Determining Collapse-Change Points in Casing Design, by *R. L. Kastor*, Shell Oil Co.

Session (2)—New Processes

9:00 a.m.

Salient Mechanical Features of Houdriflow, by *R. M. Shirk* and *D. B. Arden*, Houdry Process Corp.

Fluid Catalytic Hydroforming Units—Their Mechanical Design, by *R. A. Harang*, M. W. Kellogg Co.

Continuous Wax Molding, by *Ray Shannon*, Magnolia Petroleum Co.

Session (3)—Compressor Drivers

9:00 a.m.

Application of Gas Turbines in Gas-Transmission Lines, by *Steve Sawyer*, El Paso Natural Gas Co.

Experience With Trifuel Engines in Pipe-Line Service, by *Leonard P. Meade* and *Gerald P. Jennings*, Phillips Petroleum Co.

Welcoming Luncheon

12:00 noon

Presiding: *R. B. Kinzbach*, chairman, South Texas Section, ASME

Introductions: *L. S. Wrightsman*, chairman, Houston Arrangements Committee

Welcome: *Roy Hofheins*, Mayor, City of Houston

Response: *C. H. Shumaker*, vice-president, Region VIII, ASME

Address: *Frederick S. Blackall, jr.*, President, ASME

Subject: **The New Challenge to American Industry**

Session (4)—Hot Tapping and Branch-Reinforcement of Piping

2:30 p.m.

Design of Hot-Tap Connections in High-Pressure Pipe Lines, by *A. J. Del Buono, P. L. Vissat*, and *Frank S. G. Williams*, Taylor Forge & Pipe Works

The Mechanical Aspects of Hot Tapping, by *Burt Ver Nooy*, T. D. Williams, Inc.

Session (5)—Drilling Research

2:30 p.m.

On the Theory of Drilling Action of Rotary-Rock Bits, by *P. A. Szego*, Rice Institute

Progress Report on a Fluid-Actuated Rotary-Percussion Engine, by *W. H. Cline, Jr.*, Hughes Tool Co.

Session (6)—Refinery Materials

2:30 p.m.

Cast Iron in the Refinery, by *W. J. Buxton*, Standard Oil Co. (Indiana)

Why Prestressed Concrete in the Refinery? by *John S. Bell* and *Donald R. De Veaux*, Esso Standard Oil Co.

TUESDAY, SEPTEMBER 29

Session (7)—Unfired Pressure Vessel Code Forum

9:00 a.m.

The ASME Pressure Vessel Code—A Joint Effort for Safe Construction, by *E. O. Bergman*, C. F. Braun & Co.

Panel: *H. C. Boardman, H. B. Oatley, Walter Samans*, and *F. S. G. Williams*

Session (8)—Equipment Design

9:00 a.m.

The Application of Roller Bearings in Oil-Field Equipment, by *S. M. Weckstein*, Timken Roller Bearing Co.

High-Pressure Nitriding and Its Applications to the Petroleum Industry, by *R. L. Chenault* and *G. E. Mohnkern*, Oil Well Supply Co.

Session (9)—Well-Head Equipment

9:00 a.m.

Some Test Data and Conclusions on Casing Hangar Slip Capacity, by *E. F. Cooke, Jr.*, Beaumont Iron Works

Automatic Self-Sealing Gate Valves—An Analysis of Valve-Sealing Methods, by *Allen F. Rhodes*, McEvoy Co.

Industry Luncheons

12:00 noon

Refining, Pipe Line, Production and Drilling, Materials, and Manufacturing Committees to hold separate luncheons

Session (10)—Pipe-Line Pumping Control

2:30 p.m.

Microwave Control of Pumping Stations, by *R. C. Cheek*, Westinghouse Electric Corp.

Application of Reciprocating Pump-Valve Lifters to Closed-System Operation, by *M. T. Nigh* and *T. S. Llewellyn*, Service Pipe Line Co.

Session (11)—New Developments in Gas Compressors

2:30 p.m.

New Developments in Compressor-Equipment Design and Performance for Natural Gas-Transmission Pipe-Line Service, by *B. T. Mast*, Tennessee Gas Transmission Co.

Packaged-Compressor Plants, by *E. S. McRoberts*, J. B. Beaird Co.

Session (12)—Drilling Equipment

2:30 p.m.

Formation of Martensite on Rotary-Drilling Lines, by *C. M. Zerr*, Union Wire Rope Corp.

Utilization of Computers for Solutions of Pumping and Drilling-Equipment Problems, by *R. J. Howe* and *E. N. Kemler*, University of Minnesota

Banquet

7:00 p.m.

Presiding: *L. S. Wrightsman*, chairman, Houston Arrangements Committee

Remarks and Presentation of Student Award: *E. N. Kemler*, chairman, Petroleum Division, ASME

Address: *Lieut. General Ernest O. Thompson*, chairman, Texas Railroad Commission

Subject: **Hemispheric Solidarity in Oil**

WEDNESDAY, SEPTEMBER 30

Session (13)—Instrumentation for Pipe-Line Control

9:00 a.m.

A Capacitance-Sensitive Recorder for Pipe-Line Applications, by *Robert M. Howard* and *Howard J. EnDean*, Gulf Research & Development Co.

The Use of Radioactive Isotopes in Pipe-line Interface Marking, by *J. Kohl* and *R. L. Neviacheck*, Tracerlab Inc.

Session (14)—Materials and Methods

9:00 a.m.

Monel Protection for Off-Shore Structures, by *Thomas P. May*, International Nickel Co.

The Pipe-Line Welding Standard, by *A. G. Barkow*, Texas Illinois Natural Gas Pipe Line Co.

Session (15)—Refinery Inspection and Maintenance

9:00 a.m.

Water Cleaning of Exchangers, by *W. B. Thomas*, Texas Co.

Preventive Maintenance of Refinery Compressors, by *J. R. Ware*, Magnolia Petroleum Co.

Scheduling of Refining Maintenance, by *Cecil E. Gunter*, Gulf Oil Corp.

Session (16)—Drilling Equipment

2:30 p.m.

Power Transmission on Rotary Rigs by Friction, Fluid, and Electromagnetism, by *M. L. Rizzone*, Oil Well Supply Co.

A Practical Approach to Vibration Problems on Drilling Barges, by *T. B. Herndon* and *A. B. Reese, Jr.*, National Supply Co.

Session (17)—Pipe-Line Stress Analysis

2:30 p.m.

Introductory Problems Encountered in the Use of Strain Gages, by *Edwin D. Nuttall* and *Hale C. Goodrich*, United Gas Pipe Line Co.

Session (18)—Refractory Linings for Pressure Vessels

2:30 p.m.

Monolithic Linings for Vessels and Pipes, by *W. A. Bradbury*, Humble Oil & Refining Co.

Factors Influencing the Performance of Internal-Insulating Linings, by *C. M. Vogrin* and *J. J. Murphy*, M. W. Kellogg Co.

16th Annual ASME-AIME Fuels Conference to Be Held in Chicago, Oct. 29-30

THE Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers have announced the program for the sixteenth annual Joint Fuels Conference to be held Oct. 29-30 at the Conrad Hilton Hotel, Chicago, Ill. The Chicago Sections of both Societies are cooperating in this event.

This is the sixteenth conference in a series which began in 1937 to provide a forum before which coal users and coal producers could discuss the problems encountered in their operation and the progress made in the industry.

On Thursday, October 29, the 1953 Percy Nicholls Award will be presented to H. F. J. Hebley, Fellow ASME, research consultant of the Pittsburgh Consolidation Coal Company. Presentation of the award will be made by Clayton G. Bell of Paul Weir Company at the banquet to be held that evening.

The tentative program follows:

THURSDAY, OCTOBER 29

10:00 a.m.

Chairman: *R. E. Zimmerman*, U. S. Steel Corp.

Occurrence and Determination of Germanium in Coal Ash From Power Plants, by *R. C. Corey, J. W. Myers, W. A. Selvig*, and *L. B. Berger*, United States Bureau of Mines

11:00 a.m.

Economical Reduction of Moisture Content of Washed Coal, by *Charles E. Silverblatt* and *Donald A. Dahlstrom*, Northwestern University

12:30 p.m.

Luncheon

Speaker: *Tom Pickett*, executive vice-president, National Coal Association

Subject: **Coal and World Affairs**

2:00 p.m.

Chairman: *C. H. Sawyer*, Eastern Gas and Fuel Associates

New Developments in the Heat Drying of Coal, by *W. W. Coffin*, Link-Belt Co.

3:00 p.m.

Frontiers in Heat Extraction From the Combustion Gases of Coal, by *E. R. Kaiser*, Bituminous Coal Research, Inc.

6:00 p.m.

Cocktail Hour

7:00 p.m.

Banquet

Toastmaster: *Alex D. Bailey*

Welcome: *F. S. Blackall, jr.*, president ASME
Andrew Fletcher, president AIME

Speaker: *H. W. Johnson*, vice-president, Inland Steel Co.

Subject: **History of Steel Industry in the Chicago Area**

Presentation of the Percy Nicholls Award for 1953 to: *H. F. J. Hebley*, Pittsburgh Consolidation Coal Co., by *Clayton G. Bell*, Paul Weir Co.

FRIDAY, OCTOBER 30

10:00 a.m.

Chairman: *W. S. Major*

The Midwest Solid Fuels Situation, by *Walter H. Voskuil*, State Geological Survey

11:00 a.m.

Natural Gas Supply for Chicago and the Midwest, by *K. B. Nagler*, Peoples Gas Light & Coke Co.

12:30 p.m.

Luncheon

Presiding: *L. S. Wescoat*, president, Pure Oil Co.

Speaker: *Robert E. Wilson*, chairman, Standard Oil Co. (Indiana)

Subject: **Research in Fuels for Internal-Combustion Engines**

2:00 p.m.

Chairman: *R. B. Engdahl*

Coal-Mining Developments, by *J. D. A. Morrow*, Joy Manufacturing Co.

3:00 p.m.

Coal-Preparation Developments, by *Robert E. Sloan* and *W. McCulloch*, Roberts and Schaefer Co.

A.C.I. 13th Annual Meeting Considers Titanium Casting and Shell Molding

TECHNICAL discussions at the thirteenth annual meeting of the Alloy Casting Institute, held recently at Hot Springs, Va., covered a variety of research subjects with especial emphasis on titanium casting techniques and the newly developed shell-molding process.

Although the main product of the Institute's members is high-alloy (stainless steel) castings, the experimental production of titanium castings was discussed under the leadership of J. H. Jackson, director of A.C.I. Research Projects at Battelle Memorial Institute. Economic and strategic aspects of titanium in general and titanium castings in particular were discussed by M. G. Fontana who supervises A.C.I. Research at the Ohio State University.

Shell molding, the new technique for producing small castings of excellent surface finish to close dimensional tolerances, was discussed by H. J. Cooper, Jun. ASME, research engineer, Cooper Alloy Foundry Company, Hillside, N. J.

In addition to these papers, reports on progress of the institute's current metallurgical and foundry research in the high-temperature and corrosion fields were made by N. A. Mathews, American Brake Shoe Company, chairman of the Technical Research Committee; and W. T. Bryan, The Duriron Company, chairman of the Shop Practice Committee.

New officers of A.C.I. were elected at the annual meeting. G. A. Baker, vice-president of The Duriron Company, Dayton, Ohio, was elected to the office of president. Mr. Baker served as vice-president of A.C.I. last year, and has had wide experience in every phase of the high-alloy castings field. C. K. Lockwood, vice-president of the Stainless Steel and Alloys Division, Shawinigan Chemicals, Ltd., Montreal, P. Q., Can., was elected vice-president, and E. A. Schoefer, Mineola, N. Y., was re-elected executive vice-president and treasurer.

Woman's Auxiliary to ASME Reports on Educational Funds

THE Woman's Auxiliary to The American Society of Mechanical Engineers operating through committees on the National Board of the Woman's Auxiliary has three types of educational funds in use by deserving engineering students.

One is the Student Loan Fund, from $300 to $500, according to the student's need. At the present time 18 loans are outstanding and total $7000.

The second is the Calvin W. Rice Memorial Fund, which is a gift of $1500 to a graduate student of a foreign country, making it possible for him to do postgraduate work in the United States.

The full amount was awarded this year to Mehemet Holuk Somer of Turkey. He has a BS degree in mechanical engineering from Robert College, Istanbul, Turkey, and expects to study in the field of design, construction, and operation of farm machinery, with the view of teaching in agricultural institutions now being established or expanded in Turkey. There the need for technicians and teachers along this line is acute.

The third is the newly created Sylvia W. Farney Scholarship Award, granted this year for the first time. The award of $500 was made to Faust S. D'Avello at the University of Akron, Ohio.

The President's Page

ASME'S Importance to Management

EVERY so often, we encounter some former member of ASME, now busy with corporate affairs as a president or vice-president, who asks, "Why should I maintain my membership in the ASME? What does a fellow in my position get out of it?"

The maintenance of membership in the ASME is in some respects more important for the man who has reached the top-management level in a technical business than it is for the junior staff engineer, however immediate and obvious the benefits to the latter may be.

Of course, there is a natural tendency for all of us, as we become engrossed in executive responsibilities, to drop our more specialized technical and professional interests. In the case of ASME, where this occurs, it results, more often than not, from a failure on the part of the member to appreciate the breadth and extent of the Society's work, or its notable contributions to management and industry.

It was my privilege to attend the ASME Engineering Management Conference in Detroit last April, and I sat there spellbound while industrial leaders and top-flight engineers discussed for two days brilliantly and capably some of the very problems which confront every president or general manager of a firm whose business is based on mechanical engineering. The program would have been eminently worth two days in Detroit to anyone in the technical management field.

Aside from such matters, however, technical management should take a good long look at what the ASME is doing for the welfare of business. On this basis alone, the Society merits management's continuing interest. It would be difficult to find any single activity which has contributed more to the development and growth of young engineers—the kind which management needs so sorely—than The American Society of Mechanical Engineers. These youngsters—and many of them not so young—who are deriving continuing intellectual satisfaction and rewards from their participation in ASME work, are one of the best reasons why engineers in management should set an example by continuing active in the affairs of the Society.

If ASME, as I believe, is one of the most important factors in molding the character and competence of the technical staff, then too, most certainly the men of top management should make it their business to have a voice in its affairs. Here will be found a splendid sounding board for their views and platform for their leadership, before people whom it is important for them to know, either because they are the very backbone of their industry, or are the creators of the demand for their products and services. The Society's continuing concern with men at the management level is underscored by the affiliate membership which is provided for the man who is engaged in a technical business and directs the work of engineers, even though he, himself, may lack the technical qualifications for full professional membership in the Society.

In brief, ASME has a place for you, if you manage a company which is based on or vitally affected by mechanical engineering. Furthermore, you have a proper place in ASME. It deserves your continued membership and support, if only because of the great services which it renders to your business. But the opportunity for exchange of ideas with men of kindred interests, which ASME activity will afford you, and the effective means which it will provide you for communication with elements in industrial and professional life which it is important for you to reach, will prove very rewarding in terms of personal satisfaction as well.

FREDERICK S. BLACKALL, JR., *President*
The American Society of Mechanical Engineers

ASEE-ECPD Joint Meeting, Oct. 14–17 Program Announced

THE program has been announced for the joint meeting of The American Society for Engineering Education and the Engineers' Council for Professional Development, to be held Oct. 14–17, at the Statler Hotel, New York, N. Y. The theme of the meeting is "Civilization Is Dependent Upon the Growth of the Engineering Profession."

The members of professional engineering societies should take advantage of this opportunity to become acquainted with the forward-looking program for engineering education being promoted through the co-operative efforts of the American Society for Engineering Education and the Engineers' Council for Professional Development. Every engineer is encouraged to participate in the program outlined in the following paragraphs. Executives who employ engineers, engineers who are ambitious to broaden their knowledge of engineering and so open up new opportunities for accomplishment, and also those who have youth looking to them for advice on how to approach an engineering career, will all obtain a broader knowledge of current thinking and practice in this vital field.

Members, or others, are urged to write the Secretary of their society at once for additional information in the form of an announcement giving full detail which will be ready for distribution about September 15. A meeting like this comes to New York, N. Y., only once in a decade so that attending the sessions affords the participants a special opportunity to meet and discuss with the leaders in engineering education the latest advancements in curriculum and practice. ECPD accredits the qualified curriculums in engineering and also provides the know-how for postcollege orientation and specialized engineering development. It also provides aids to high-school students desiring to enroll in engineering schools.

The ASEE Conference Program

WEDNESDAY, OCTOBER 14

8:00 a.m.
ASEE Executive Board Meeting Breakfast, Engineers' Club, 32 West 40th St., New York, N. Y.

10:30 a.m.
Meeting of ASEE Executive Board with chairmen of ASEE divisions, ASCE Board Room, 29 West 39th St., New York, N. Y.

12:00 noon
ECRC Executive Committee Meeting Luncheon, Engineers' Club
Presiding: *Eric Walker*, vice-president ASEE

2:00 p.m.
ASEE General Council Meeting (Members of Council only) ASCE Board Room
Presiding: *L. E. Grinter*, president ASEE

6:30 p.m.
ASEE General Council Dinner

7:30 p.m.
ASEE General Council Meeting
Presiding: *L. E. Grinter*, president ASEE

THURSDAY, OCTOBER 15

All events at Statler Hotel, New York, N. Y.

The following meetings and luncheon sponsored by ECRC and ECAC are open to all ASEE and ECPD members and representatives. The morning program will present speakers of national reputation for creative achievements in art, poetry, and music.

9:30 a.m.
Conference
Theme: Creativeness in the Arts and in Engineering
Presiding: *Eric A. Walker*, vice-president ASEE

12:30 p.m.
Luncheon
Presiding: *L. E. Grinter*, president, ASEE
Speaker: *Morris I. Stein*, University of Chicago
Subject: **A Psychologist Looks at Creativeness**

2:00 p.m.
Conference
Theme: Creativeness in Engineering
Presiding: *W. L. Everitt*, vice-president ASEE
Speaker: *Maurice Nelles*, director Borg-Warner Laboratory
Subject: **The Engineering Point of View**
Speaker: *Fred Olson*, vice-president for research and development, Olin Industries
Subject: **The Industrialist's Point of View**

6:30 p.m.
ECAC Executive Committee Meeting Dinner
Presiding: *W. L. Everitt*, vice-president ASEE

The ECPD Conference Program

THURSDAY, OCTOBER 15

All events at Engineers' Club

6:00 p.m.
Informal Dinner for members of ECPD

7:30 p.m.
Closed Session, ECPD

8:30 p.m.
Open Session for all interested: Committee Reports, and reports of society participation in ECPD, adoption of budget, and election of officers for 1953–1954

FRIDAY, OCTOBER 16

All events at Hotel Statler, New York, N. Y.

9:30 a.m.
Engineering Accrediting Session
Chairman: *Thorndike Saville*, chairman, ECPD Education Committee
Vice-chairman: *Nelson S. Hibshman*, assistant secretary, AIEE
Speaker: *Ewald B. Nyquist*, Secretary, Middle States Association
Subject: **The National Commission on Accrediting, the Middle States Association, and the Relations of Their Programs With That of the ECPD Program of Engineering Accrediting**
Speaker: *Gregory Dexter*, consulting engineer, Scarsdale, N. Y.
Subject: **Our Neglected Future Engineers**—a discussion of the weaknesses of present accrediting processes
Speaker: *L. E. Grinter*, president ASEE
Subject: **Findings of the ASEE Educational Evaluation Study as They Relate to Accrediting**
Discussion on the above presentations
Summary of Discussion: *S. C. Hollister*, past-president ASEE

12:30 p.m.
Luncheon
Presiding: *Col. L. F. Grant*, chairman, ECPD
Speaker: *General A. G. L. McNaughton*, chairman, Canadian Section of International Joint Commission
Subject: **Water Problems on the Canadian-United States Boundary**

2:30 p.m.
Postcollege-Training Session
Chairman: T. H. Chilton, chairman, Engineering Manpower Commission
Speaker: *Cornelius Wandmacker*, chairman, ECPD Training Committee
Subject: **Plans and Results of ECPD Experimental Training Program at Cincinnati**

Engineering Manpower Utilization Panel
Case Histories of better utilization methods
H. N. Muller, Jr., Westinghouse Electric Corp.
Leslie H. Middleton, The Electric Autolite Co.
Chester Brisley, Calumet & Hecla, Inc.

7:00 p.m.
Annual Engineers' Dinner
All members of ECPD participating societies are cordially welcome
Presiding: *Henry T. Heald*, vice-chairman ECPD
ECPD Annual Report: *Col. L. F. Grant*, chairman ECPD
Speaker: *Horace P. Liversidge*, chairman of the board, Philadelphia (Pa.) Electric Co.
Subject: **Industry and Engineering Education**

SATURDAY, OCTOBER 17

Open for Committee Meetings as needed

ASME Calendar of Coming Events

Sept. 21–25
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Sherman Hotel, Chicago, Ill.
(*Final date for submitting papers was May 1, 1953*)

Sept. 28–30
ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas
(*Final date for submitting papers was May 1, 1953*)

Oct. 5–7
ASME Fall Meeting, Hotel Sheraton, Rochester, N. Y.
(*Final date for submitting papers was June 1, 1953*)

Oct. 29–30
ASME Fuels Division and AIME Coal Division Joint Conference, Conrad Hilton Hotel, Chicago, Ill.
(*Final date for submitting papers was June 1, 1953*)

Nov. 29–Dec. 4
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(*Final date for submitting papers was July 1, 1953*)

March 10–12, 1954
ASME International Meeting, Hotel Del Prado, Mexico City, D. F.
(*Final date for submitting papers—Nov. 1, 1953*)

June 14–17, 1954
ASME Oil and Gas Power Conference, Hotel Muehlebach, Kansas City, Mo.
(*Final date for submitting papers—Feb. 1, 1954*)

June 20–24, 1954
ASME Semi-Annual Meeting, William Penn Hotel, Pittsburgh, Pa.
(*Final date for submitting papers—Feb. 1, 1954*)

Sept. 8–10, 1954
ASME Fall Meeting, Hotel Schroeder, Milwaukee, Wis.
(*Final date for submitting papers—May 1, 1954*)

Sept. 13–24, 1954
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Commercial Museum and Convention Hall, Philadelphia, Pa.
(*Final date for submitting papers—May 1, 1954*)

Sept. 26–29, 1954
ASME Petroleum Mechanical Engineering Conference, Statler Hotel, Los Angeles, Calif.
(*Final date for submitting papers—May 1, 1954*)
(*For Meetings of Other Societies, see page 760*)

Lewis Ketcham Sillcox
Nominated for President

ASME OFFICERS *Nominated for* 1953–1954

DURING the Semi-Annual Meeting of The American Society of Mechanical Engineers in Los Angeles, Calif., June 28–July 2, 1953, Lewis Ketcham Sillcox, vice-chairman of the board, The New York Air Brake Company, New York, N. Y., was nominated by the National Nominating Committee for the office of President of the Society for the year 1953–1954.

Regional Vice-Presidents named by the Committee to serve for two-year terms on the Council of ASME were Willis F. Thompson, renominated, New Haven, Conn.; William G. McLean, Easton, Pa.; Thompson Chandler, South Charleston, W. Va.; Vernon A. Peterson, Los Angeles, Calif.; and C. H. Shumaker, for one year, Dallas, Texas.

Directors at Large named by the Committee to serve a four-year term on the Council were Frank L. Bradley, Passaic, N. J., and Robert B. Lea, New York, N. Y.

Members of the Committee making the nominations were Harry E. Harris, Sr., Bridgeport, Conn., representing Region I; William H. Bryne, New York, N. Y., representing Region II; George M. Muschamp, Philadelphia, Pa., representing Region III; Karl P. Hanson, Raleigh, N. C., representing Region IV; W. A. Carter, Detroit, Mich., representing Region V; R. S. Stover, Marshalltown, Iowa, representing Region VI; A. R. Weigel, Los Angeles, Calif, representing Region VII; and R. P. Lockett, Jr., New Orleans, La., representing Region VIII.

Election of ASME officers for 1953–1954 will be held by letter ballot for the entire membership, closing Sept. 29, 1953.

Biographical sketches of the nominees follow on the succeeding pages.

ASME NEWS

Nominated for President

Lewis K. Sillcox

LEWIS KETCHAM SILLCOX, who has been nominated to serve for one year as President of The American Society of Mechanical Engineers, is the vice-chairman of the board of The New York Air Brake Company.

Mr. Sillcox, who lives in Watertown, N. Y., has spent his entire career in the railroad industry, where he has been one of the active but unassumingly influential engineers who have contributed immensely to the development of improved methods of railway-power application and the control of railway trains.

During the past 25 years Mr. Sillcox has been responsible for developing the brake-cylinder release valve which eliminates hand-bleeding retained air in standing freight cars, improved sanding methods for rail conditioning, the brake-pipe flowmeter which registers brake-pipe pressure in freight and passenger trains irrespective of main supply head pressure, and basic brake types (freight, passenger, and locomotive).

He also sponsored the designing of several types of aircraft hydraulic pumps now found on practically all current military aircraft and the latest commercial aircraft.

Mr. Sillcox, the son of George W. and Georgiana (Parker) Sillcox, was born in Germantown, Pa., April 30, 1886. After having been graduated from Trinity School in New York, N. Y., in 1901, and attending L'École Polytechnique in Brussels, Belgium, for a year, he became an apprentice in the shops of the New York Central Railroad. Thereafter he was a supervisor and shop engineer in manufacturing plants until 1912 when he became mechanical engineer of the Canadian Northern Railway System, which now is a component part of the Canadian National Railways. Returning to the United States in 1916, he was mechanical engineer of the Illinois Central Railroad and then general superintendent of motive power of the Chicago, Milwaukee & St. Paul Railway. Since 1927 he has been first vice-president of The New York Air Brake Company where his notable qualities as a technician, leader, and organizer in the field of railway engineering were instrumental in bringing about developments of importance. In 1948 he was made a director of the company, the following year was elected executive vice-president, and in 1952 vice-chairman of the board. He serves in the capacity of an executive officer of the board of several other large companies.

The ASME Gold Medal was awarded to Mr. Sillcox in 1943 for distinguished service in engineering and science. He has been described as a "pre-eminent learned technologist—lover of wisdom—inspirer of men." He has been for many years a lecturer to Purdue University, Northwestern University, the Harvard Graduate School of Business Administration, Yale University, Massachusetts Institute of Technology, Princeton University, Ohio State University, Syracuse University, and Clarkson College of Technology on subjects relating to railway practice and applied mechanics. He is honorary curator of transportation of the Baker Library of Harvard University, and trustee of Clarkson College. Mr. Sillcox's writings are extensive and have been of inestimable value to the railroad-transportation field.

He was elected chairman of the Mechanical Division of the American Railway Association for the year 1926–1927; in 1952–1953 he served as chairman of the Papers Committee of the Eighth Pan-American Railway Congress, the first such congress held in the United States. From 1934 to 1936 he was chairman of the Mechanical Advisory Committee of the Federal Co-Ordinator of Transportation. On June 5, 1946, he was awarded the Gold Medal of the Institution of Locomotive Engineers of Great Britain in recognition of the excellence of his paper "Power to Pull" which covered a method for appraising the relative performance of steam and diesel locomotives. He was the recipient of the Salzberg Memorial Award presented by Syracuse University in 1949.

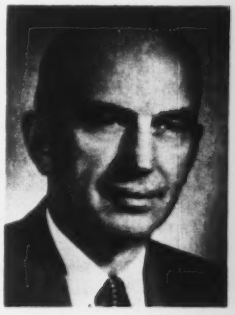
He is an Honorary Member of ASME, to which he has belonged since 1916 and to which he has given invaluable committee service. He was made an Honorary Member of the Society in 1946. Since 1942 he has been designated permanent chairman of the ASME Metals Engineering Handbook Board.

Mr. Sillcox has received honorary degrees in science from Clarkson College, in engineering from Cumberland and Purdue Universities, and in laws from Syracuse University.

He holds various grades of membership in the leading professional and technical societies both in the United States and abroad; he takes an active part on the advisory councils of numerous educational and cultural institutions, and honorary societies; and maintains memberships in many social clubs and fraternal associations.

Nominated for Regional Vice-President

To Serve Two-Year Terms



W. F. THOMPSON

W. G. MCLEAN

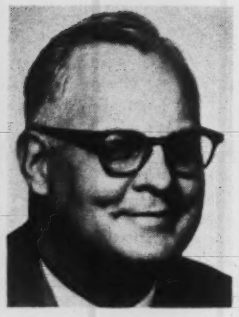
Willis F. Thompson

WILLIS FREDERICK THOMPSON, who has been renominated from Region I to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Woodbridge, Conn., Dec. 11, 1895. He was graduated from New Haven High School and attended Yale University as a special student in mechanical engineering.

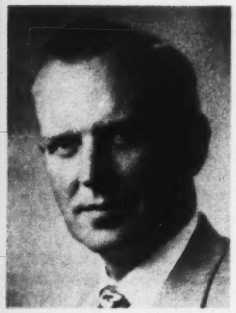
He has been associated with Westcott and Mapes, Inc., architects and engineers, New Haven, Conn., since 1916, beginning his work as chief draftsman and later filling the positions of mechanical engineer and chief mechanical engineer. In 1929 he was elected a director and assistant secretary of Westcott and Mapes and in 1946 became vice-president, which position he now holds.

He was with the Ordnance Department, U. S. Army, from 1917 through 1919, designing and constructing steam-electric generating plants for government-owned arsenals and armories. During World War II he was a member of the Connecticut State Guard.

Mr. Thompson became a member of ASME in 1919 and has always taken an active part in local, state, and national affairs of the Society. He is a past-chairman of the New Haven Section and has been a member of the General Committee of Connecticut sections and of the Connecticut Sections Committee for the 1949 National Spring Meeting held in New London, Conn. From 1947 to 1949 he was an ASME delegate to the Connecticut Technical Council and during this time was chairman of their Student Guidance Committee which was active in its contacts with students in the various high schools throughout the State. He has also been a delegate to the Regional Administrative Conference of ASME. His participation in national activities of ASME



THOMPSON CHANDLER



V. A. PETERSON

C. H. SHUMAKER

include: Member, Nominating Committee, Power Show Advisory Committee, Membership Development Committee, and ASME representative on United Engineering Trustees and Engineering Foundation, serving on several of their committees. He is a member of the Power Piping Code Committee, the Meetings Committee of ASME, and chairman, National Guidance Committee of the Engineers Council for Professional Development.

He is licensed to practice engineering in the states of Connecticut, Massachusetts, and New York. He is a member of the Connecticut and National Societies of Professional Engineers. His memberships in other organizations are: New Haven Kiwanis Club, of which he is a past vice-president; New Haven Chamber of Commerce, of which he is a director and 1953 chairman of the Industrial Development Committee; New Haven Commandery No. 2, K.T.; American Legion, Woodbridge (Conn.) School Board; Woodbridge Republican Town Committee; Zoning Board of Appeals; Woodbridge Club; Engineers' Club, New York, N. Y., and Quinnipiack Club, New Haven.

William G. McLean

WILLIAM GEORGE MCLEAN, who has been nominated from Region III to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Scranton, Pa., March 15, 1910. In 1932 he was graduated from Lafayette College with a BS degree in electrical engineering and the following year he received an MS degree in mathematics from Brown University.

From 1934 to 1937 he was engaged as a teacher of mathematics and sciences and head of the department of mathematics at the West Scranton, Pa., High School. In 1937 he joined the teaching staff at Lafayette College as assistant professor where he taught mechanical-engineering subjects including kinematics, mechanics, strength of materials, machine design, and heat power. During this period he also was co-ordinator of civil pilot training. For the next two years he was senior physicist and assistant to the superintendent of the Special Products Division of Eastman Kodak Company at Rochester, N. Y. He was engaged in the manufacture of fire-control equipment and research work. In 1946 he returned to Lafayette as associate professor and head of the department of mechanics. He is a professional engineer registered in the State of Pennsylvania.

Professor McLean became a junior member of ASME in 1938 and a member in 1947. He was chairman of the Anthracite-Lehigh Valley Section, 1948–1949; member, Regional Delegate's Conference, 1949 and 1950; member, National Nominating Committee, 1951; and secretary of Region III for the past two years.

His membership in other engineering societies includes the following: American Society for Engineering Education, Pennsylvania Society of Professional Engineers, Engineer's Club of the Lehigh Valley, and American Ordnance Association.

He is the coauthor with E. W. Nelson of the "Outline of Theory and Problems in Engineering Mechanics." He has been elected to membership in the honorary societies Phi Beta Kappa, Tau Beta Pi, and Sigma Xi.

Thompson Chandler

THOMPSON CHANDLER, who has been nominated from Region V to serve two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Chicago, Ill., March 20, 1906.

He received his engineering education at Lehigh University, Bethlehem, Pa., where he was graduated in 1929 with a degree of chemical engineer. Upon graduation he was employed by the Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation. Starting in the production department, Mr. Chandler served first as a cadet engineer, carrying out experimental work on various plant operations, then as an operating unit sub foreman supervising several production units under a unit foreman. In 1931 he transferred to the research and development department to supervise the design, construction, and maintenance of equipment and facilities, and the operation of service facilities. From 1945 until 1949 he was actively engaged in the design and construction of the multimillion dollar Research Center for the Carbide and Carbon Chemicals Company at South Charleston, W. Va. At the present time Mr. Chandler is head of the General Engineering-Service Division of the research and development department.

Mr. Chandler became a member of ASME in 1946 and has served the Society as vice-chairman, West Virginia Section, 1949–1950; chairman, 1950–1951; member of the Executive Committee, 1947–1948 and 1949–1953; chairman of the Membership Development Committee, 1949–1950; sponsor, 1951–1953; sponsor, Honors and Awards Committee, 1951–1952. In 1950 and 1951 he served as a delegate both to the Region V Administrative Conference and the Regional Delegates Conference. From 1950 to 1953 he was a member of the Region V Sections Committee, and was the chairman of this committee in 1952–1953. In 1952 he served on a subcommittee of the National Membership Development Committee which redrafted the ASME Membership Development Guide.

Mr. Chandler is a registered engineer in the State of West Virginia, a member of the American Institute of Chemical Engineers, American Chemical Society, American Ordnance Association, and an associate member of the Brooklyn Botanical Garden. He is a member of the Board of Trustees of the Kanawha Presbyterian Church, serving as chairman in 1952, a member of the West Virginia Extension Committee, Ohio-West Virginia Area YMCA, treasurer and a director of the Carbide Hunting and Fishing Club. He is a Chi Phi; an associate member of the Press Club of Charleston, W. Va.; and a member of the University Club, Cleveland, Ohio.

Vernon A. Peterson

VERNON ARNELLO PETERSON, who has been nominated from Region VII to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Denbigh, N. Dak., May 25, 1906. He was graduated from the North Dakota State College, at Fargo, in 1928, with a BS degree in mechanical engineering.

His entire career has been spent in the employ of the Elliott Company of Jeannette, Pa. In 1928 he joined the company as a sales-engineering apprentice and from 1929 to 1934 he was application engineer in the turbine department. Then for six years he was assigned as sales engineer in Kansas City, Mo., followed by two years in the same capacity in Denver, Colo. In 1940 he was transferred to Los Angeles, Calif., by the company and was made district manager, which position he still

holds. He is a registered professional engineer in the State of California.

Mr. Peterson became a junior member of ASME in 1935 and a member in 1942. He has been an active member of the Society and has served in the Southern California Section as follows: 1944–1945, program chairman; 1945–1946, secretary-treasurer; 1946–1947, vice-chairman; and 1947–1948, chairman. Active in professional engineering interests, he has been president of the Los Angeles Engineering Council; president of the California Legislative Council of Professional Engineers, 1949–1950; and has been on the ASME Legislative Committee since 1947.

His memberships in other clubs and societies include the Los Angeles Engineers' Club, Electric Club of Los Angeles, California Natural Gasoline Association, Del Mar Club in Santa Monica, and Al Malaikah Temple, A.A. O.N.M.S.

Clifford H. Shumaker

CLIFFORD HAROLD SHUMAKER, who has been nominated from Region VIII to serve for one year as Regional Vice-President of The American Society of Mechanical Engineers, was born in St. Joseph, Mo., Oct. 25, 1907. He was graduated from the University of Kansas in 1930 with a BS degree in industrial engineering. In 1944 he received a professional degree of mechanical engineer from the University. In 1929 he took the Westinghouse Test Course.

His association with the Southern Methodist University began in 1930 as an instructor in mechanical engineering. From 1933 to 1936 he was assistant chief draftsman with the consulting engineers' firm of Paulett and Wilson in Salina, Kans. In 1936 he returned to SMU where he has been assistant professor, associate professor, and professor of mechanical engineering. Since 1952 he has been chairman of the department of industrial engineering. In addition to his regular work on the campus he has also been director of these activities at SMU: from 1940 to 1944, the War Training Program; 1946 to date, Ordnance Gage Laboratory; since 1947, The Institute of Building Material Distribution; and since 1948, The Institute of Management.

Professor Shumaker became a junior member of ASME in 1938 and a member in 1941. He has been a member of the ASME Medals Committee since 1952. He is a member and Institutional Representative, Southwest Section of the American Society for Engineering Education; the American Association of University Professors, and Sigma Tau. He was a recipient of the Sigma Tau Medal and has received an ASME Certificate of Award. He is a registered professional engineer in the State of Texas.

Nominated for Director at Large

To Serve Four-Year Terms

F. L. BRADLEY

R. B. LEA

Frank L. Bradley

FRANK LEO BRADLEY, who has been nominated to serve as Director at Large of The American Society of Mechanical Engineers for a four-year term, was born in Boston, Mass., on July 21, 1897. He attended the Massachusetts Institute of Technology and was graduated with a BS degree in mechanical engineering in 1920.

Shortly after graduation he joined A. B. Franklin, Inc., consulting engineers and contractors, in Boston, Mass., as an engineer and estimator. In 1923 he was employed by Stone & Webster Engineering Corporation as a designer of steam-power stations. Later, as office engineer for this company over a period of three years, he was connected with the administration of engineering of hydro and steam-power projects. During the remaining six years of his association with this company, he was responsible for the mechanical design of numerous industrial and utility-power stations, serving as assistant chief mechanical engineer for part of this period.

In 1931 he joined the Forstmann Woolen Company, Passaic, N. J., as assistant plant engineer, becoming plant engineer, and currently engineering manager of the company. During this period he has been responsible for the construction as well as the maintenance and operation of these facilities. His work has covered a broad scope of industrial operation and design, including development of many textile units which have been patented by the company. These projects include developments in high-speed spinning of worsted yarns and the continuous indigo dyeing of wool stock. Mr. Bradley was made vice-president of the Garfield Warehouse and Transportation Company in 1945.

Mr. Bradley became a junior member of the Society in 1920; a member in 1930; and a life member in 1952. He has been active in the Metropolitan Section in the capacity of both treasurer, 1951–1952, and chairman, 1952–1953. He has served as a member and chairman of the ASME Textile and Power Divisions. He was associated with the Publications Committee for a period of seven years, two years as chairman. He is currently a member of the Section VII Committee of the Boiler Code Committee of the Society. He is a registered professional engineer in New Jersey and New York.

He is a member of various civic organizations and other technical societies.

Robert B. Lea

ROBERT BROOKE LEA, who has been nominated to serve as Director at Large of The American Society of Mechanical Engineers for a four-year term, was born in Methuen, Mass., on July 22, 1891. He received his training in mechanical engineering at Cornell University, where he arranged a five-year engineering course in order to take in some foreign language and other courses. All basic engineering at Cornell is now a five-year course. In 1915, at the end of his fourth year, he left Cornell to join the Sperry Gyroscope Company.

From 1915 to 1948 Mr. Lea was employed by the Sperry Gyroscope Company. Starting in 1915 with various engineering and factory assignments he advanced until in 1917 he became comanager of the ship-stabilizer department where he helped to direct sales-engineering activities and the construction of gyro ships' stabilizers, from equipment for small yachts and submarines to destroyers and 10,000-ton naval vessels. He holds several patents on ship-stabilizer details. In 1924 he was made marine sales manager; then successively, sales manager, vice-president, and vice-president for public relations. He transferred from the Sperry Gyroscope Company to The Sperry Corporation in 1948, serving as special assistant to the president. Since 1949 he has held the position of coordinator of exports.

Mr. Lea became a life member of ASME in 1946. His service to the Society is as follows: member of the Aviation Division in 1946; Executive Committee, Aviation Division 1948; and chairman, Executive Committee, Aviation Division, 1951–1953. He represents the President of ASME on the Fiftieth Anniversary Powered Flight, 1953; and is ASME representative on the Daniel Guggenheim Award Committee. He has given numerous lectures before various Sections and Student Branches of the Society. He also is a member of other professional societies.

Policies on ASME Budget for 1953–1954

THE following statement of policies with the schedule of income and expense constitutes the Budget for 1953–1954.

1 A continuous effort will be made to collect dues.

2 No appropriation shall be made by Council without first referring back to the Finance Committee for recommendation. When a liability is assumed the means for paying for it shall be provided in advance.

3 No new activity shall be undertaken without definitely showing that the funds required to support it will be available without decreasing the appropriations for existing essential activities, giving the consideration to the administrative expense that may be involved. When a new activity is authorized, if the additional funds to support it are not directly available from the unappropriated income, Council shall say what activity shall be curtailed or suppressed to permit transference of the fund required to support the new activity. If the budget of expenses is to be reduced, the Council shall say what activity shall be curtailed or suppressed.

4 The Society shall hold four general meetings with expense chargeable to the budget. A fee shall be charged to nonmembers for admission to general or technical sessions at the four meetings of the Society according to rules established by the Board on Technology. No payments will be made for rental of rooms for the holding of technical sessions.

5 Council meetings shall be held at the place and time of the Annual and Semi-Annual Meetings. Council representation within the budget shall be provided for the other national meetings.

6 Within the allowance of the budget, Vice-Presidents shall be expected to visit Sections and Student Branches and attend Student Branch Conferences in their Regions or arrange for visits by their representatives.

7 No travel allowance will be provided for Board and Committee Chairmen attending Council Meetings except upon special provision of Council or the Executive Committee.

8 Eight Regional Administrative Committee meetings will be held.

9 A Regional Delegates' Conference will be held at the place of the Semi-Annual Meeting.

10 The Nominating Committee may hold a preliminary meeting at a place to be selected and a Selection Meeting at the Semi-Annual Meeting within the provisions of the budget.

11 The following uniform basis of contributions toward travel expense shall be adopted.

For meetings of the Council, the Vice-Presidents (when meeting at some other time and place than the Council), the Nominating Committee, the Regional Administrative Committees, and the Regional Delegates' Conference:

For Transportation by Rail—Full railroad fare including Pullman (not to exceed roomette rate) plus government tax; Air—Airplane

COMBINED ANALYSIS OF EXPENDITURE BUDGET 1953–1954

Under Committee Supervision

	Direct Expenditures	Joint Bodies	Members Travel	Printing and Distribution	Office Expense	Total
PUBLICATIONS, STANDARDS, CODES, AND RESEARCH						
MECHANICAL ENGINEERING text pages (excluding student copies)				$ 90,000.00	$ 48,938.00	$ 138,938.00
MECHANICAL ENGINEERING advertising pages (excluding student pages)				160,100.00	130,901.00	291,001.00
Transactions (including *Journal of Applied Mechanics*)	$ 1,100.00			14,300.00	41,526.00	56,926.00
Membership List				12,000.00		12,000.00
"Know Your Society" (organization charts)				1,000.00		1,000.00
ASME Catalog				55,000.00	39,045.00	94,045.00
Publication sales (except standards, codes, and research reports)				82,500.00	20,587.00	103,087.00
Standards and Codes		$ 1,000.00		67,000.00	89,318.00	157,318.00
Research				1,500.00	25,095.00	26,595.00
GENERAL SOCIETY ACTIVITIES						
Society meetings (including publicity)	40,000.00				23,974.00	63,974.00
Sections (including Regional Administration Committee of Regional Delegates Conference)	85,000.00		$21,100.00		20,211.67	126,311.67
Professional Divisions	11,000.00				16,370.00	27,370.00
Student Branches (including copies of MECHANICAL ENGINEERING text and advertising pages)	8,200.00		4,800.00	31,000.00	14,519.93	58,519.93
Admissions					23,844.67	23,844.67
Development					9,023.33	9,023.33
Awards	1,100.00				842.40	1,942.40
Engineers Civic Responsibility	500.00					500.00
GENERAL SOCIETY ADMINISTRATION						
Council	2,300.00		13,000.00			15,300.00
Professional Services (auditors, counsel, etc.)	6,500.00					6,500.00
Nominating Committee			2,800.00			2,800.00
Retirement Fund	50,000.00					50,000.00
OINT ACTIVITIES						
Engineering Societies Library		17,000.00				17,000.00
Engineers' Council for Professional Development		2,100.00				2,100.00
Engineers Joint Council		4,000.00	800.00			4,800.00
Engineering Societies Personnel Service, Inc. (reserve)		500.00				500.00
Registration (National Council of State Boards of Engineering Examiners)		500.00				500.00
UET Pension Fund		3,700.00				3,700.00
American Society for Engineering Education		700.00				700.00
National Management Council		500.00				500.00
INDIRECT EXPENSE						
Secretary's office					70,124.00	70,124.00
Accounting department					56,492.00	56,492.00
General service (stores, mailing, filing, etc.)					109,336.00	109,336.00
General office (rent, insurance, etc.)					55,509.00	55,509.00
TOTAL	$205,700.00	$30,000.00	$42,500.00	$514,400.00	$795,657.00	$1,588,257.00

fare plus government tax; and Automobile—Six cents per speedometer mile for the car used except that the amount shall not exceed railroad first-class fare.

For Time on Travel—$6 per day for each day or major part thereof of actual time on travel on trips of 100 miles or more (not to exceed travel time by standard railroad route).

For Time at Meeting—$6 per day for the days or major parts thereof required for the business of the stated meeting. This payment is not made to a member who resides at or near the place of meeting unless lodging away from home is required.

These payments will be made upon submission of a report on a form supplied by the Secretary.

For Student Branch Conference—20 cents per mile for each Student Branch Delegation, including the honorary chairman. Student delegations under this provision may consist of (*a*) the honorary chairman, (*b*) the honorary chairman and at least one student delegate, or (*c*) one or more student delegates.

Visits of Presidents and Vice-Presidents or their designated representatives to Sections, Branches, etc.—out of pocket expense within budgetary limits prescribed.

12 Payments to the Sections for Operation shall be on the basis of the Standard Formula plus 25 per cent.

The Standard Formula is: $3.50 per member for the first 75 members, $1.50 per member for the next 425, $1.25 per member for the next 500, $1.00 per member for all over $1,000, and $150.00 to each Section for each authorized Subsection.

Supplementary payments equal to one third of a dollar for each paid-up member in the Section on September 30, this supplementary payment to be made only on a specific request from the Section showing necessity for it, and with the approval of the Vice-President, the additional payment to be made with the second payment to the Section.

Any payments to a Section in addition to those paid on the Standard Formula shall require authorization by the Council.

Payments by the Section shall be made in accord with the Sections Operation Manual, and the Secretary's Staff has authority to deny reimbursement for payments not so made.

13 Grants of Society funds for Section, Division, and Student Branch operations shall not be used for social events.

14 The Society shall have two representatives on the American Standards Association.

15 No publications shall be printed for sale unless there is reasonable assurance of sufficient orders to pay for the cost.

International Relations Centers for Scientists and Engineers Announced

THE National Academy of Sciences recently established a program in recognition of the importance of broadening international co-operation at the level of the individual scientist or engineer. Since the visits of foreign scientists to this country afford an excellent opportunity for cementing professional friendships and associations and for furthering scientific co-operation, the Academy has given considerable thought to the development of regional programs which can bring United States scientists into closer contact with visiting colleagues. Each year the United States is receiving an increasing number of scientific visitors from foreign countries which are expanding their scientific organizations.

During the past year, the Cooperative Research Foundation (CORE) has evolved a program to establish international relations centers in areas of scientific activity and ports of entry for scientific visitors from other nations.

The main functions of the regional centers will be: (1) to facilitate contacts between the visiting scientists and scientific personnel in the area; (2) to serve as a coordinating agency for international scientific activities in the area; (3) to offer such assistance to visiting scientists as other institutions of the area may not be equipped to give.

The Office of International Relations of the National Academy of Sciences—National Research Council has offered its co-operation in this program and will assist in the operation of the regional centers by making available its channels of communication to the U. S. Department of State, Government agencies, and sister academies and research councils abroad. These sources supply information regarding the travel plans and objectives of foreign visitors and provide the contacts necessary for an effective program.

The first of these centers was opened on Aug. 31, 1953, in the Morrison Planetarium, Golden Gate Park, San Francisco, Calif. The California Academy of Sciences is co-operating with the Cooperative Research Foundation in the initiation of this program. CORE's policy committee for the Center, drawn from its San Francisco membership, includes M. A. Stewart, dean, University of California Graduate School; Robert Miller, director, California Academy of Sciences; Karl Meyer, director, Hooper Foundation; Robert Champion, president, Cooperative Research Foundation; George Tenney, president, McGraw-Hill Company of California; John Alison, president, Transit Van Corporation; and Belford Brown, vice-president, The San Francisco Bank, (chairman). The Center will seek to evolve an active program which will allow scientific and engineering groups in the San Francisco Bay area to participate in this experiment in international relations.

ASME Membership as of July 31, 1953

Honorary Members	53
Fellows	381
Members	13,721
Associates	338
Juniors (33 and over)	3,384
Juniors (30–32)	2,004
Juniors (to the age of 29)	17,836
Total	37,717

Scientific Societies Take Part in NSF Program to Gather Information on 100,000 Scientists and Engineers

REGISTERS of scientific and technical personnel are now being compiled by four professional scientific societies with support from the National Science Foundation. Six additional societies also plan to take part in this Foundation program to set up comprehensive decentralized registers to provide information on the nature and supply of scientists and engineers in the United States. Up-to-date information on about 100,000 scientists and engineers is expected to be on hand by June, 1954, and by June, 1955, it is expected that registers will have been established in all major fields of science.

The National Science Foundation is authorized and directed by the Congress "to maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel in the United States."

The registers now being compiled or planned will become basic tools for supply and demand studies for trained manpower in various fields of science. These decentralized registers will also serve as standby machinery which will aid in the event of an emergency in identifying and locating scientists with special skills.

The Foundation has received the records on about 135,000 scientists compiled over several years by the National Scientific Register, U. S. Office of Education. This previous register has provided information for a series of reports on scientific manpower and will continue to be used for such purposes until the Foundation's decentralized registers are completed. Information from the former register will also be supplied to societies taking part in the new program.

The four societies already engaged in the new program are: American Geological Institute, American Institute of Biological Sciences, American Veterinary Medical Association, and Federation of Associated Societies for Experimental Biology.

Additional societies that have indicated a desire to participate in the program include the American Mathematical Association, the American Institute of Physics, the American Chemical Society, the American Meteorological Society, and the Engineers' Joint Council. The American Medical Association will cooperate with the biological societies in developing their registers.

The participating societies expect to send questionnaires both to members and to nonmember scientists in their respective fields. Information gathered from the questionnaires will be maintained by each society on punched cards to simplify handling and analysis. Duplicate sets of cards will be given to the Foundation.

The registers will be kept current by the societies who will extend coverage to include newly trained specialized personnel and others not previously registered.

Meetings of Other Societies

Sept. 19–27
International Foundry Congress, Paris, France

Sept. 21–24
American Mining Congress, 1953 mining convention, Olympic Hotel, Seattle, Wash.

Sept. 28–30
American Management Association, personnel conference, Hotel Statler, New York, N. Y.

Sept. 28–Oct. 1
Association of Iron and Steel Engineers, annual convention, William Penn Hotel, Pittsburgh, Pa.

Sept. 28–Oct. 3
Fifth international mechanical-engineering congress, Turin, Italy

Sept. 29–Oct. 3
Society of Automotive Engineers, national aeronautical meeting, Statler Hotel, Los Angeles, Calif.

Oct. 6–7
National Fluid Power Association, first fall meeting Sheraton, Hotel, Chicago, Ill.

Oct. 7–8
International symposium on progress in rubber technology, Delft, The Netherlands

Oct. 8–9
American Society for Quality Control, eighth Midwest conference, Masonic Temple, Davenport, Iowa.

(ASME Calendar of Coming Events, see page 753)

People

CLEMENT J. FREUND, Fellow ASME, dean of the University of Detroit college of engineering, was honored for 20 years of contributions to the university, the city, and the nation by the Detroit City Common Council, June 21, 1953. Dean Freund was presented with a framed copy of the resolution citing his notable achievements. In the evening he was guest of honor at a dinner held at the Engineering Society of Detroit.

* * *

WALTER T. WELLS, chairman of the board of directors of the Lane-Wells Company, was named the fifteenth winner of the Marston Medal for achievement in engineering at the eighty-second annual commencement at Iowa State College on June 12, 1953. The Marston Medal is awarded to an engineering alumnus of Iowa State College in recognition of achievement in engineering.

* * *

BENJAMIN F. GREENE, JR., of the Air Force Cambridge Research Center, Air Research and Development Command, USAF, Cambridge, Mass., is the 1953 recipient of the Thurman H. Bane Award, given annually to an officer or civilian of the U. S. Air Force for an outstanding achievement in aeronautical development.

WILLIAM B. BRIDGEMAN, engineering test pilot, Douglas Aircraft Company, Inc., received the Octave Chanute Award, presented annually to a pilot for a notable contribution to the aeronautical sciences. The formal presentation of these two awards by The Institute of the Aeronautical Sciences was made on the occasion of the IAS annual summer meeting dinner, July 15, Hotel Statler, Los Angeles, Calif.

* * *

NATHANIEL HOWELL FURMAN, Russell Wellman Moore professor of chemistry and chairman of the department of chemistry, Princeton University, has been selected to receive the 1953 Palladium Medal of The Electrochemical Society. Presentation of the medal will take place on September 15, at Wrightsville Beach, N. C., during the fall meeting of The Electrochemical Society. He is a former president of the American Chemical Society.

* * *

HIS ROYAL HIGHNESS THE DUKE OF EDINBURGH has accepted Honorary Membership in the Engineering Institute of Canada. Recently His Royal Highness was president of the British Association for The Advancement of Science.

* * *

GEORGE A. HAWKINS, Mem. ASME, assumed his duties as the new dean of engineering at Purdue University in July, with the retirement from service of A. A. POTTER, Hon. Mem. ASME, who has headed the five engineering schools at Purdue for the past 33 years. Dr. Potter became dean emeritus.

* * *

ROBERT C. DISQUE, dean of the faculty and since 1933 dean of the college of engineering of Drexel Institute of Technology, retired August 31, and HARRY L. BOWMAN, head of the department and professor of civil engineering, succeeded him in both posts.

Dr. Disque, who has been associated with the Institute since 1919, has been named dean emeritus and professor emeritus of electrical engineering.

* * *

CLARK M. HUMPHREYS has been appointed as acting director of research for the American Society of Heating and Ventilating Engineers by the Council on June 29 at the semi-annual meeting in Denver, Colo.

* * *

P. J. UNDERWOOD has been appointed executive secretary of the Society of Plastics Engineers.

* * *

SIR WILLIAM OGG, director of the Rothamsted Experimental Station, became president of the Society of Chemical Industry, following the 72nd annual meeting of the society held in Nottingham, England, July 20–25. At this meeting LOUIS A. JORDON, director, Paint Research Station, Teddington, was the 29th recipient of the Medal of the Society of Chemical Industry, awarded not more than once every two years for conspicuous service to applied chemistry.

Junior Forum

Conducted by Joseph Schmerler, Jun. ASME

Boston Reporting: How One Section Has Stimulated Interest and Activity in Its Junior Membership

By Peter Stein[1]

THE plans and aspirations of those who founded the Junior Committee in the Boston Section in 1947, are becoming a reality through the diligent work of generations of Committee members and officers. This Junior Committee functions as an open committee: Its meetings are open to all Junior members in the Boston area. Candidates for office, however, must attend at least two of the eight committee meetings of the previous season in order to be eligible to run in the annual elections. Since new members join voluntarily rather than by appointment or election, the Junior Committee faces problems not met by any of the other regular committees in the Section in attracting members.

Thus it was not until 1951 that the Committee was able to be directly helpful to the Boston Section, although some indirect benefit had become evident. During that season, the Program Committee of the Boston Section decided to sponsor three triple-interest meetings as part of the regular program: A dinner for the entire Section, followed by talks on three different topics given simultaneously in separate halls. The Juniors were allotted one talk at each of two such meetings. These two trials were so well received that the Program Committee saw fit to set aside three such meetings for the Juniors during the following season, and four have been requested for next year. At those sessions, the topics presented are primarily of interest to junior engineers; they represent material which would not otherwise be presented at Section meetings, such as:

When to change your job
Should engineers join unions?
What does Professional Engineers' Registration mean to the junior engineer?

and occasionally a topic along popular science lines such as:

Focusing Sound Waves With Microwave Lenses.

In order to prepare these meetings and conduct regular business, monthly Committee meetings have been held regularly since 1949. These meetings are attended by a continuing

[1] Teaching assistant, mechanical-engineering department, Massachusetts Institute of Technology, Cambridge 39, Mass. Jun. ASME.

group of Juniors so that each year the Committee includes members who have attended such meetings in previous years, and who help guide the practices and policies of the new Junior Committees.

A relatively new feature at these meetings is the premeeting speaker. The business meeting is preceded by a short talk by one of the members either in the field of his specialty or about an unsolved engineering problem on which he is working. Discussions resulting from such talks have been lively and, in some instances, helpful, so that this practice will be continued in future years.

The position of the Junior Committee is such that it represents no one tangible interest such as Power or Applied Mechanics; rather it serves as a proving ground for ASME members. One of the functions which this Junior Committee is endeavoring to fulfill, is the training of future manpower for the Senior Section. A substantial number of Junior-Committee members have "graduated" to responsible positions in the Boston Section. Such graduates include vice-chairmen, secretary-treasurers, committee chairmen, and the like.

Another service which the Junior Committee has claimed is the summarization of Section Meetings. Summaries of all talks presented at Section Meetings are prepared by Junior-Committee members and are subsequently published in the bimonthly Junior newssheet, *The Pinion*.

The Pinion is a newly-born venture of the Boston Junior Committee and consists of a four or five-page mimeographed newssheet containing special interest features for Juniors, such as the Section Meeting summaries, future program previews, Junior news, and general interest items. This pamphlet is mailed to 300 Juniors and it is hoped that *The Pinion* will make its first *printed* appearance next season, as a regular, self-supporting venture.

In order to preserve the continuity of the Junior Committee during the summer months, and also to further social contact between members, an annual summer outing has been held for the past two years. These affairs are arranged by the Committee, and all its members and their wives, and friends are invited for the weekend.

The Junior Committee is financed by the Boston Section to the extent of from $4 to $10 annually to cover mailing expenses. All other costs such as refreshments at meetings, stationery, and so on, are furnished by the members who have established a small fund for these purposes.

The aims of the Boston Junior Committee have been the subject of much discussion, but over-all agreement has been achieved on the major point: The Committee exists to serve the ASME Juniors in the Boston area, and it does so in a variety of ways:

1 Keeping Juniors informed about the activities of the Committee and of the Section through the mailing of Minutes and of *The Pinion*.

2 Serving as a reservoir for future manpower for the Boston Section.

3 Fostering the acquaintance of Juniors' outside meetings through the annual outing.

4 Sponsoring sections of triple-interest meetings with topics of appeal to Juniors.

5 Encouraging Juniors to participate fully in Section Meetings and in Regional and National Contests.

6 Assisting the Student Branch Committee Chairman by furnishing speakers from the Committee to talk on their experience in industry, education, and ASME.

7 Providing enough work for those Juniors who attend Committee meetings to stimulate their interest and imagination.

Thus, although the active membership of the Junior Committee in the Boston area is only about 20, the unstinting efforts of its members through the years have created an ASME Committee with spirit, imagination, cohesiveness, continuity, and persistence to serve Boston area Juniors, and to create for them an opportunity to participate more fully in ASME.

Campaign to Ease Engineering Manpower Shortage Showing Results

RECENT intense campaigns to reduce the nation's critical shortage of engineers "are starting to pay off." Louis M. Stark, manager of the Westinghouse Electric Corporation's school service department, recently reported that while the picture is far from bright, it is "heartening to note a 29 per cent increase in the number of college and university freshmen who enrolled in engineering courses in 1952."

Mr. Stark spoke at an inaugural dinner at the start of a six weeks' Summer Fellowship Program at the Massachusetts Institute of Technology for 50 high-school science teachers from 32 states. The program is sponsored by the Westinghouse Educational Foundation, which is supported by Westinghouse Electric Corporation.

Emphasizing that there will continue to be a great need for more and more engineers, Mr. Stark said the most recent encouraging fact is that while enrollment on the whole moved upward 11 per cent, engineering enrollment in 1952 jumped 29 per cent.

"In 1951, some 40,000 freshmen enrolled in engineering and this group will produce about 22,000 graduates in 1955," he pointed out. "In 1952 the enrollment of first-year engineering students rose to about 52,000, justifying an estimate of 29,000 graduates in 1956. This is still not sufficient to meet the country's basic needs, but it shows a rapid improvement."

The increase in the number of engineering freshmen last year, Mr. Stark said, is proof that the efforts of engineering societies, industries, universities, and high-school science teachers have had a marked effect in steering young people into careers in technical fields. He told the high-school science teachers that the role they play in increasing the nation's engineering manpower supply is a vital one since "the university, industry, and society at large depend on you for a continuing supply of young men and women ready to pursue a college course or productive tasks in industry."

Of primary importance, he added, is the need for high-school science teachers to keep the science curriculum up to date and in keeping with the needs of society. There is also a need, in addition to modern curriculums, for informed guidance and for the teaching of science as a part of general education.

U. S. Army Scientific and Professional Personnel Program

THE U. S. Army Scientific and Professional Personnel Program should be of special interest to recent engineering graduates who shortly will be inducted into the armed forces because it was designed to channel as many such persons as possible into Army billets which will insure the maximum utilization of their engineering or scientific training and experience for their own continued professional development and for the advancement of the Army's technical programs.

The program is described in detail in Department of the Army Special Regulation No. 615-25-11, dated Aug. 7, 1952.

The regulations provide for the identification, classification, assignment, and utilization of those persons who are qualified to perform scientific and professional-level duties in research and development, instruction, and related work of professional or scientific nature.

The objects of the program are stated as follows:

1 Insure that military personnel who have had scientific and professional training are utilized in military duties related to their training to the greatest extent possible.

2 Make known to the Department of the Army Information concerning availability of individuals qualified to meet immediate or future requirements for scientific and professional personnel on an Army wide basis.

3 Enable the development of a system for indicating requirements for scientific and professional personnel and for requisitioning such personnel.

Commanders of reception centers and other installations conducting initial reception processing are responsible for the proper identification and indoctrination of scientific and professional personnel and for their transfer to appropriate basic training.

The regulations concerning the selection of Scientific and Professional Personnel are far too complex for adequate reproduction here.

Personnel qualified as Scientific and Professional Personnel are assigned a Military Occupational Specialty number (MOS) which reflects their specialty and is intended to be used as a guide in their assignment to billets in which their training and experience will be utilized. All the major engineering and scientific fields are covered by the regulation although, as has been said previously, the qualifications differ somewhat.

Copies of the basic regulation are available from the Department of the Army, Washington 25, D. C.

The Engineering Manpower Commission of Engineers Joint Council is interested in the efficiency of the Scientific and Professional Personnel program. It feels that the dissemination of information regarding the existence of the program is vital to its success.

Actions of the ASME Council at a Meeting Held in Los Angeles, Calif., June 28–29

THE Council of The American Society of Mechanical Engineers met in four sessions at the Statler Hotel, Los Angeles, Calif., on June 28–29, during the 1953 ASME Semi-Annual Meeting. The following were present at one or more of the sessions: Frederick S. Blackall, jr., president; J. Calvin Brown, James M. Todd, W. H. McBryde, and E. W. O'Brien, past-presidents; B. G. Elliott, S. H. Graf, E. H. Hanhart, H. R. Kessler, C. H. Shumaker, E. S. Theiss, W. F. Thompson, and P. R. Yopp, vice-presidents; J. L. Cucullu, P. B. Eaton, R. L. Goetzenberger, H. E. Martin, D. W. R. Morgan, and A. C. Pasini, directors at large; C. E. Davies, secretary; E. J. Kates, assistant treasurer; G. M. Muschamp, Constitution and By-Laws Committee; Crosby Field, Board on Technology; K. P. Hanson, H. E. Harris, and A. R. Weigel, Nominating Committee; C. M. Sandland, L. F. Richardson, and W. Julian King, Southern California Section; J. B. Armitage, H. L. Eggleston, L. E. Herbert, S. D. Moxley, guests. The following Regional Delegates were also present: C. E. Crede and D. A. Fisher, Region I; W. S. Johnston and E. S. Rowell, Region II; R. G. Tessmer and R. W. Worley, Region III; J. W. Little and A. C. Ormond, Region IV; A. B. Heiberg and J. S. Jefferds, Jr., Region V; R. D. Teece, L. S. Whitson, and R. W. Mills, Region VI; R. L. Johnson and R. E. Wiegand, Region VII; and C. W. Crawford, Region VIII.

Region VIII Vice-President

It was reported that by letter-ballot action Clifford H. Shumaker had been approved for appointment as vice-president of Region VIII for the remainder of the Society year.

Policies and Budget

After discussion it was voted to approve the policies and the budget for 1953–1954. (The budget appears on pages 758-759 of this issue.)

Amendments to Constitution

The Engineers' Council for Professional Development is attempting to bring the grades of membership in the major engineering societies into better agreement as to terminology and qualifications. Upon recommendation of ECPD the Council voted to endorse the necessary changes in the Constitution and to submit to the Business Meeting on June 29, 1953, the proposed amendments to the Constitution. These are: Article C3, Sec. 1 (Membership), Article C4, Sec. 4, 5, 6 (Qualifications for Admission), and Article C5, Sec. 1, 2, 3 (Fees and Dues). For an account of these proposed amendments, see report on Business Meeting, MECHANICAL ENGINEERING, August, 1953, page 680.

Amendments to By-Laws

As a result of the proposed constitutional changes, amendments will be necessary in related By-Laws and Rules. The following proposed amendments were received for first reading: Article B5, Pars. 11 and 12 (Fees and Dues) which substitute the word Affiliate for the word Associate; and Article B6A, Par. 18-C (Boards and Committees) which substitutes the words Associate Members for the words Junior Members.

It was also voted to adopt amendments to Article R3, Rule 2 (Membership) and Article R4, Rules 1, 2 (Qualifications for Admission) to become effective upon adoption of the related changes in the Constitution. These amendments also deal with changes in the names of grades of membership.

The Council voted to adopt amendments to B6A, Par. 17-B (Boards and Committees) which received first reading Nov. 30–Dec. 1, 1952.

The following proposed amendments were received for first reading: B6A, Pars. 14, 14-B, 14-D, 14-E, 18 (Boards and Committees). These proposed amendments concern mainly the duties and personnel of the Board on Technology, the Publications Committee, and the Research Committee.

Honorary Members

Upon recommendation of the Board on Honors, the Council elected the following men Honorary Members of the Society: Edward L. Cochrane, Cambridge, Mass.; William A. Hanley, Indianapolis, Ind.; A. C. Monteith, Pittsburgh, Pa.; Sheppard T. Powell, Baltimore, Md.; and William F. Ryan, Boston, Mass.

1953 Awards

Upon recommendation of the Board on Honors, the Council approved the following awards and honors for 1953:

ASME Medal to Crosby Field, Fellow ASME, Brooklyn, N. Y.

George Westinghouse Gold Medal (First Award) to Alexander G. Christie, Hon. Mem. ASME, Baltimore, Md.

Holley Medal to Philip Mowry McKenna, Mem. ASME, Latrobe, Pa.

Worcester Reed Warner Medal to William H. McAdams, Mem. ASME, Cambridge, Mass.

Melville Medal to Jefferson C. Falkner, Fellow ASME, New York, N. Y., for his paper, "Quick-Starting of Large High-Pressure, High-Temperature Boilers."

Richards Memorial Award to Thomas Melvin Lumly, Tulsa, Okla.

Pi Tau Sigma Award to Merl Baker, Lexington, Ky.

It was reported that the 1953 Gantt Medallist will be Thomas E. Millsop, president, Weirton Steel Company, Weirton, W. Va. This award is sponsored jointly by ASME and the American Management Association.

Charles T. Main Topic for 1954

The Council approved "The Engineer in Business and Industry" as the Charles T. Main Topic for 1954.

Spirit of St. Louis Junior Award

It was voted to authorize the modification of the rules governing the Spirit of St. Louis Junior Award which is presently governed by a Council action which states that the award shall be made every third year. The new rule will read "the Award shall be made at the discretion of the Council of the Society and shall occur approximately every three years and the name of the winner shall be made known simultaneously and in conjunction with the announcement of the name of the recipient of the Spirit of St. Louis Medal."

Civic Affairs Committee

The change of name of the Engineers Civic Responsibility Committee to "Civic Affairs Committee," was approved.

Developing Specialized Interests

After discussion of a report on Developing Specialized Interests, the Council voted to request the Organization Committee to submit at the 1953 Annual Meeting, proposals for procedures which will permit the selection of Directors from others than leaders in Sections and Regional Activities.

The Council also authorized an appropriation of $6000 for the Organization Committee to circularize the entire membership to ascertain their special interests and skills as a base for studying specialized interests, organization, and improvement.

75th Anniversary

It was reported that the Task Committee on the Seventy-Fifth Anniversary Celebration of the Society is actively working on the development of a pattern for the meeting, a suggested committee organization, and an estimate of costs, which will be available September, 1953.

Policy to Improve Meetings and Publications

A report presenting a Policy to Improve Meetings and Publications of the Society was approved as a desirable objective to be attained as soon as possible.

Publications Committee

A report of the Working Group on Transactions and Preprints of the Publications Committee was discussed at length. The Board on Technology was requested to review it promptly and make definite recommendations to the Council at its November, 1953, meeting.

Reader-Interest Review

Appropriation of $5000 for Reader-Interest Review of MECHANICAL ENGINEERING was voted, subject to approval by the Finance Committee.

1954 Semi-Annual Meeting

The Council voted to approve holding the 1954 Semi-Annual Meeting of the Society in Pittsburgh, Pa., June 20–24.

International Instruments Exhibition

It was voted to approve the request of the Instruments and Regulators Division to contract with the Instrument Society of America to secure exhibitors for ten booths at the International Instruments Exhibition to be held in Philadelphia, Pa., September, 1954.

Fellow-Grade Requirements

The requirement for promotion to the Fel-

low grade that a Member be in the grade of Member for 13 years has been under discussion for a number of years. The Board on Membership, in February, 1951, recommended: "That the 13-year period for the Fellow grade be waived in any instance where eminence is proven, but that the candidate must have previously held or been of the Member grade; this to be followed by a recommendation of the Admissions Committee and upon unanimous vote of the Council." This proposal was placed on the 1952 agenda of the Regional Delegates Conference for proper action. After further discussion by the Board on Membership and the Admissions Committee, it was agreed that no steps be taken to change the present requirements.

AIEE Agreement

Conferences have been held with representatives of the American Institute of Electrical Engineers regarding an arrangement by which a member of one of the two societies might join the other without paying an entrance fee. The AIEE Committee on Planning and Coordination will appoint a subcommittee to confer with ASME representatives. The Council authorized the Board on Membership to develop a proposal for a reciprocal arrangement on entrance fees which can be acted on by the AIEE Board and the ASME Council.

History of Boiler Code

Appreciation was expressed by the Council to Dr. Arthur M. Greene, Jr., for his careful and painstaking documentation of the Boiler-Code History. Eight installments of this history have appeared in MECHANICAL ENGINEERING to date.

Public-Relations Committee

A recommended public-relations program was submitted by a Special Committee on Public Relations. Action on the report was deferred until the November, 1953, meeting. The Council, however, voted to approve the recommendations (1) that ASME public relations be made a responsibility of the Board on Public Affairs, and (2) that at least one member of the Board have extensive experience in public-relations activity.

"Applied Mechanics Reviews"

The agreement with Midwest Research Institute for the preparation of material for *Applied Mechanics Reviews* was extended for one year, expiring September, 1954.

Resolution of Thanks

A resolution was adopted expressing the thanks of the Society to members of the Southern California Section and others who contributed to the success of the 1953 Semi-Annual Meeting.

Joint Meeting With EIC

It was reported that the ASME-EIC International Council requested a joint meeting of the Councils of ASME and EIC in Montreal in 1956. This request was referred to the Board on Technology.

Certificates of Award

Certificates of Award were granted to the following retiring chairmen of Sections: Charles E. Greeley, Washington, D. C.; Robert L. Johnson, San Francisco; F. James McCanna, Oregon; H. R. Neifert, Canton-Alliance-Massillon; Clifford M. Sandland, Southern California; Nicholas M. Trapnell, Virginia.

Student-Branch Councilors

The Council approved the designation of Student-Branch Councilors as appointive officers of the Sections, one for each Student Branch in the area of the Section. The Councilor would have the following duties:

(1) He will be available to the Student Chairman and Honorary Chairman of the Student Branch to aid and advise on Student-Branch programs and activities and to mobilize the resources of the Section and the Society for that purpose.

(2) He will serve as the agent of the Society to carry to the Student Branch and explain Society policies particularly on promotion from Student Member to Junior, on the provision for inactive status during service in the armed forces, and on the offerings of prizes and awards by the Society.

EJC Constitution

Engineers Joint Council recently voted two changes in its Constitution. The ASME Council approved the changes which are as follows: *Sec. 1*, A national engineering society may become a constituent society of the Council upon meeting the following qualifications: (*a*) The corporate or voting membership shall be confined to individual members, (*b*) a majority of individual members shall be either graduates of engineering colleges of recognized standing or shall be licensed or registered by a State Board of Registration for Professional Engineers, (*c*) have a total membership of at least 5000 individual members of which the majority must meet the above requirements, (*d*) receive the affirmative vote of not less than two thirds of the constituent societies of Council. *Sec.* 3, Member societies of EJC may resign from membership upon a 90-day written notice to the Secretary of EJC.

The first paragraph of Article V, Sec. 1 was amended to read as follows: 1. Executive Committee—There shall be an Executive Committee consisting of the President of the Council as chairman, the Vice-President of the Council as vice-chairman, and one representative from each of six other constituent societies elected by Council.

ECPD

After discussion, it was voted to support the position of Engineers' Council for Professional Development as the authoritative accrediting agency for the engineering profession and to require that any review of an educational process be made only through procedures approved by ECPD.

Regional Delegates Conference

Recommendations of the 1953 Regional Delegates Conference were received and it was voted to refer them to the committees concerned for report. Appreciation and thanks were expressed to the Regional Delegates for their work.

Deaths

The Council noted with regret the deaths of Walter S. Finlay, Jr., and Spencer Miller, Sr., in June. Both were former Council members. The Secretary reported with regret the death, on May 26, 1953, of Harry W. Edwards, Office Manager of the Society, and the death on May 29, of Harry R. Cobleigh of the Publications Department.

Appointments

The Council approved the following appointments:

R. C. Allen, to Nuclear Energy Application Committee

A. C. Monteith to Engineers' Council for Professional Development

C. D. Albert to dedication, Thurston and Kimball Halls, Cornell University, June 13

S. E. Reimel to Chamber of Commerce of U. S. Conference June 10.

Executive Committee of Council Holds Special Meeting

A special meeting of the Executive Committee of the Council was held at the Statler Hotel, Los Angeles, Calif., June 30, 1953. F. S. Blackall, jr., presided. In addition to Mr. Blackall there were present: H. E. Martin, E. S. Theiss, W. F. Thompson of the Council; J. W. Barker, chairman, Meetings Committee; and C. E. Davies, secretary.

Special Appropriation

The meeting was called to consider a communication from the Metropolitan Section of the Woman's Auxiliary regarding a reduction in appropriation for the women's events at the 1953 Annual Meeting. After discussion, the President was authorized to establish an advisory committee to the Meetings Committee to look into the processes followed in financing all social expenses at Society meetings. The committee will consist of J. W. Barker, chairman; H. E. Martin, Council representative; and S. C. Williams, Finance Committee. Mrs. U. A. Rothermel and Mrs. C. M. Hickox will be advisers to the committee.

An appropriation of $250 was authorized for the Metropolitan Section of the Woman's Auxiliary. This is subject to review by the Finance Committee.

Coming Meetings

Solar Energy

THE National Science Foundation announced a grant of $6000 to the University of Wisconsin, Madison, for joint support of a scientific conference on solar energy and its utilization to be held Sept. 12–14, 1953.

The conference will bring together physical scientists and engineers from the United States and abroad to assess present knowledge of

solar-energy utilization and to point out needed areas for basic research in the physical and engineering sciences.

The world's energy supply from fossil fuels, such as coal, oil, and natural gas, is limited and in some regions nonexistent. Effective conversion of solar energy into readily usable forms of heat, light, and power would solve the problem of diminishing fuels for an indefinite period.

The conference will be concerned with other aspects of solar-energy utilization. The scientists will discuss such subjects as conversion of solar energy into other energy forms, such as electricity and heat; storage of solar energy in various ways including chemical reactions; and the use of fluid-solid phase changes and crystal alterations as mechanisms for energy storing. The findings and recommendations of the conference will be published and given wide circulation among scientists and engineers.

Instrumentation

THE eighth National Instrument conference and show which will be held Sept. 21–25, 1953, at the Sherman Hotel, Chicago, Ill., will survey the broad field of instrumentation. Co-operating with the Instrument Society of America in presenting the technical sessions are the Instruments and Measuring Committee of the American Institute of Electrical Engineers; the American Institute of Physics; the Industrial Instruments and Regulators Division of The American Society of Mechanical Engineers; the Professional Group on Instrumentation of the Institute of Radio Engineers; and the Scientific Apparatus Makers' Association.

The second Analytical Instrument Clinic will be held during the conference. The clinic, which will consist of a lecture and demonstration course on complex analytical instruments, will appeal particularly to technicians, chemists, physicists, and engineers. Electronic, optical, and mechanical-design features will be covered as well as details of application.

The program and registration forms for the clinic may be obtained by writing to Dr. Axel H. Peterson, Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa.

Electronics

THE ninth annual National Electronics Conference will convene Sept. 28–30, 1953, at the Sherman Hotel, Chicago, Ill.

The technical program offers 99 papers covering a broad field of electronic research, development, and industrial application and is supplemented by over 140 exhibits by manufacturers foremost in the electronics field.

The conference is sponsored by the American Institute of Electrical Engineers, Illinois Institute of Technology, Institute of Radio Engineers, Northwestern University, University of Illinois with Purdue University, University of Wisconsin, the Radio-Television Manufacturers Association, and the Society of Motion Picture and Television Engineers participating.

Advance registration may be made by writing to National Electronics Conference, Inc., Karl Kramer, Executive Secretary, 852 East 83rd Street, Chicago 19, Ill.

Material Handling

THE second in a series of "Traveling Clinics" on material handling scheduled for 1953 by The Material Handling Institute will convene October 2 at the Sheraton-Plaza Hotel, Boston, Mass.

The purpose of the Traveling Clinics is to develop among users a better understanding of the correct application of material-handling equipment to industry's pressing problems.

The Boston clinic will be an all-day meeting, divided into five separate panel discussions, meeting concurrently, according to general types of problems presented such as receiving and shipping problems and multistoried-building problems. Each panel will have a specialist in each general type of material-handling activity. For example, one specialist on each panel will be prepared to advise on the proper use of industrial gasoline and electric trucks, powered hand trucks, storage batteries, and accessories. Another will discuss overhead and monorail cranes and hoists. Others will cover conveyers; floor and hand trucks, wheel, and caster equipment; and pallets, steel wire, and strapping. Each discussion group will be led by a moderator.

The first clinic met in New York, N. Y., on June 10, 1953. The Boston clinic is the second. Other clinics are being planned for major industrial centers of the country.

Water Supply and Sanitation

THE Bureau of Yards and Docks of the Department of the Navy is sponsoring an Advanced Base Water Supply and Sanitation Symposium to be held Oct. 7–9, 1953, at the U. S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, Calif. The purpose of the symposium is to bring together military personnel, scientists, and practicing engineers to explore and discuss the requirements, problems, and current and future developments of water supply and how it is affected by related field sanitation. All discussions will be directed toward the development of new equipment and practices that might assure a safe water supply and simplify logistics and field operations for military personnel in forward areas.

General topics scheduled for discussion include: The military problem, desalting of sea water, water purification, sanitation, polar and arid water supply, and future trends and possibilities. In planning the discussion emphasis has been placed upon theories, special requirements, and unique solutions that are adaptable to military operations.

Anyone desiring to attend the symposium should write the Officer in Charge, U. S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, Calif.

What's Engineering?

AN increasing interest in engineering, shown by high-school students in recent months, has led to publication of a new booklet "What's Engineering?" about the profession by Stevens Institute of Technology, Hoboken, N. J. Designed to answer questions about the work engineers do, the 16-page publication also discusses the scholastic attainments and special aptitudes which indicate whether a student should seek admission to an engineering college.

The first part of the booklet deals separately with engineering research, design, development, and production. Later, in considering the engineer's future, it points out that today one engineer is needed for every fifty industrial workers, against one engineer for 300 workers in 1890 and that there promises to be a greater need for engineers in industry.

Along the same line, it states that only half the engineering graduates of the past 25 years are still on purely technical assignments. The remainder either have moved into executive or managerial positions or have entered a variety of businesses or professions, ranging from banking and law to farming.

Young men are cautioned against going into engineering, despite the promise it seems to hold, unless they show ability in high-school mathematics and science. Regarding aptitudes, they are told that a boy who happens to be handy with tools is not necessarily cut out for an engineering career. In order to become an engineer, he must "have the capacity to learn how to design or even improve the radio or motor he enjoys repairing."

Education

Giannini Memorial Fund

THE establishment of a Mario C. Giannini Memorial Fund in honor of the late assistant dean of New York University's college of engineering was announced May 29, 1953, by Thorndike Saville, dean of the College.

The principal of the fund was contributed by Professor Giannini's friends and colleagues. The income from the fund will be used to provide an annual award to a mechanical-engineering graduate of the Evening Division of the college of engineering who, in his undergraduate career, has demonstrated "outstanding promise of usefulness in his profession."

Mathematical Sciences

THE Institute of Mathematical Sciences has been established by New York University as a center for mathematical research closely integrated with advanced training. Graduate courses will be given under the auspices of the Graduate School, but the activities of the Institute will not be restricted by departmental lines.

The Institute aims at co-operation with other academic institutions and research establishments in the New York region. Its objective is to improve opportunities for mathematical research and training and to help attain a sound balance between "abstract" and "applied" aspects of mathematical endeavor.

Various groups will be combined to form the Institute. The division of mathematics and mechanics is primarily concerned with basic research in all fields of mathematics ranging from numerical analysis and mathematical physics to number theory. Another division is centered around research in electro-

magnetic theory, and a third will operate a Univac computing machine under contract with the Atomic Energy Commission and study the practical aspects of numerical analysis. Expansion in the fields of mathematical physics, statistics, probability, and related fields is planned.

The Institute issues a quarterly journal, *Communications on Pure and Applied Mathematics*, of which five volumes have already appeared. This journal primarily publishes papers originating at the Institute, but occasionally papers are solicited from other authors.

Industrial and Traffic-Accident Prevention

THE fall term evening program in industrial and traffic-accident-prevention training offered by the Center for Safety Education, New York University, begins September 21, 1953. The present curriculum makes it possible for students enrolled for a full program of eleven courses to fulfill requirements for a Certificate in Industrial Safety, or a Certificate in Traffic Safety. Students may also elect courses in fields of special interest.

Information about these courses and activities may be secured by writing the Center for Safety Education, New York University, Washington Square, New York 3, N. Y.

Dynamic Equipment Policy

A NATIONAL center to conduct education and research in the methods of industrial-equipment acquisition and replacement will be established this fall in the department of business and economics at Illinois Institute of Technology, sponsored by the Machinery and Allied Products Institute and Illinois Institute of Technology.

The center is to be known as the National Center of Education and Research in Dynamic Equipment Policy.

The center will have two basic objectives: (1) The wide dissemination of information as to enlightened equipment policy; and (2) Sustained study of improved techniques and continued analysis of the problems and practices of business in this field.

Nuclear Engineering

DEGREES in nuclear engineering will be granted at Kansas State College beginning with the coming college term. The college conferred with Atomic Energy Commission representatives before submitting the new curriculum to the Regents for approval. The AEC has had to train the usual type of engineering graduates to work with the Commission and its subcontractors.

The nuclear-engineering curriculum combines fundamentals of atomic-energy and radiotracer techniques with basic engineering courses in mechanics, unit operations, thermodynamics, and design.

In the curriculum students will also study problems in control, heat transfer, materials of construction, waste disposal, and safety, and other problems met in developing atomic energy.

Management Seminars

MORE than 2000 business executives from all parts of the country are expected to participate in the 20-week fall program of management seminars announced by the American Management Association.

From August 10, 1953, through January 27, 1954, the association will sponsor some 130 educational seminars dealing with 86 specific management problems, compared with 85 seminars on 52 subjects in the corresponding period last year. Most of the meetings will be held at A.M.A.'s Management Center in New York, N. Y.; others will be at the Palmer House in Chicago, Ill., and at the Hotel Statler in Detroit, Mich.

These seminars are part of A.M.A.'s over-all program of management education, which also includes a dozen large conferences each year: a five-week course in the basic principles, skills, and tools of management; a research and information service; a continuing survey of executive compensation; and a number of publications. Nearly 25,000 executives participated in one or more of these activities during the past fiscal year.

Two types of seminar are scheduled for this fall. Workshop seminars, discussion groups for exchange of information and experience; and orientation seminars, for instruction, practice, or review in a particular management subject.

Additional information and copies of the seminar announcement may be obtained by writing Seminar Registrar, American Management Association, 330 West 42nd Street, New York 36, N. Y.

Cathodic Protection

WHAT is believed to be the first short course on cathodic protection offered by an American university will be given Oct. 12–16, 1953, at University of Illinois, Urbana. The National Association of Corrosion Engineers is co-operating with the university in presenting the course. Prof. Ray Wainwright of the university's electrical-engineering staff is co-ordinator.

The sessions will cover practical information useful to operating and engineering personnel. A college degree is not a prerequisite for registration, which is limited to 50 persons. Registration information may be obtained from Prof. R. K. Newton, 713½ South Wright St., Champaign, Ill. Cost of the 5-day course is $47.50, payable to the university.

Scholarship Offered to Women

A $1200 scholarship for a year's graduate study in engineering with special emphasis on aeronautics has been announced by Zonta International, an organization of women executives. Applications for the grant, which is called the Amelia Earhart Graduate Scholarship for Women, should be filed with Zonta International, care of Miss J. Winifred Hughes, Syracuse University, Syracuse 10, N. Y., by March 1, 1954.

NSF Establishes Scientific Translations Center at Library of Congress

A CENTER for holding and photoduplicating foreign scientific translations has been established by the National Science Foundation in the Science Division of the Library of Congress. Partial support for the project has been contributed by the U. S. Atomic Energy Commission. Establishment of the translations center is part of a Foundation program to assist American scientists in keeping informed about current scientific progress in other countries.

Scientific translations will be collected from many sources, including Government agencies, scientific societies, industrial laboratories, and universities. Initially, the center will put major emphasis upon translations from Russian scientific journals, although it is hoped eventually to add material from other languages for more comprehensive coverage of the world's scientific literature. Monthly lists of translations newly received will be issued by the Library of Congress. The monthly listings will include notices of translations that are available by direct purchase from commercial and other translating services, but the center will not supply photocopies of such material.

The price list established by the center for copies of translations is as follows: Photostats or enlarged microprints: 1 to 10 pages, $1.25; 11 to 15 pages, $1.75. Microfilms: 1 to 50 pages, $1.

Inquiries about the new service should be addressed to the Scientific Translations Center, Science Division, Library of Congress, Washington 25, D. C.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Sept. 25, 1953, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

NEW APPLICATIONS

For Member, Associate, or Junior

ADAMS, CARL J., Saginaw, Mich.
AUCOIN, THEODORE A., JR., New Orleans, La.
AYERS, EMORY D., South Charleston, W. Va.
BAILEY, BRUCE M., Carlisle, Mass.
BALLOU, GEORGE R., Rochester, N. Y.
BARTAS, JACOB G., Newark, N. J.
BATCHELLER, ROY W., Los Angeles, Calif.
BENNETT, J. DOUGLAS, Grosse Pointe Park, Mich.
BISHOP, JOHN F., Los Angeles, Calif.
BORCHARDT, BENJAMIN, Los Angeles, Calif.
BRENNAN, JOSEPH F., San Francisco, Calif.
BROWN, WILLIAM T., Oak Ridge, Tenn.
BURÉ, HERBERT P., Djakarta, Indonesia
CAPPER, ROBERT W., Bay City, Mich.
CAPPS, FRANK R., Jacksonville, Fla.
CAVANAUGH, RICHARD D., Watertown, Mass.
CHAO, HSIEN SUI, Houston, Texas
CHAPLIN, WALTER R., Darien, Conn.
CLEMMER, JOHN G., JR., Havertown, Pa.
CROWE, THOMAS A., Glasgow, Scotland
DARLINGTON, STEPHEN P., New York, N. Y.

DEKONING, FRANCIS P., Atlanta, Ga.
DENNIS, FRED S., Oak Ridge, Tenn.
DEUTSCH, ALEXANDER T., Cincinnati, Ohio
DEVOGE, CHARLES S., Wichita, Kans.
DUNSTONE, EMERSON C., Wellsville, N. Y.
EDLING, GUSTAF E., Stockholm, Sweden
ELLIOTT, VORRAS A., Schenectady, N. Y.
EMANUELE, ANTHONY J., Newark, N. J.
EVANS, RICHARD, Mexico, D. F., Mex.
EYKMAN, FERNAND, Valley Stream, N. Y.
FAHLAND, FRANK, Omaha, Neb.
FERNANDO, MICHAEL D., Colombo, Ceylon
FISHER, NORMAN R., Sacramento, Calif.
FLOYD, HORACE G., Havelock, N. C.
FOX, CLIFFORD S., Flushing, N. Y.
FREY, MAX, Ashland, Ohio
GODFREY, CECIL, Amberley, Sussex, England
GREEN, LEUMAS W., JR., Jacksonville, Fla.
HAAS, JAMES P., Newtown, Pa.
HANLEY, LEONARD J., New Hartford, N. Y.
HAQ, NAYAR U., Karachi, Pakistan
HARNISH, JAMES R., York, Pa.
HARRINGTON, JAMES P., Wilmington, Del.
HEDRICH, OTTO H., Pasadena, Calif.
HERRMANN, GEORGE, New York, N. Y.
HOBBINS, ERNEST F., Philadelphia, Pa.
HOLBROOK, ROSSITER, Hanover Center, Mass.
HYDE, PAUL E., Vancouver, Wash.
JONES, DONALD W., Chattanooga, Tenn.
KINSLER, MARTIN R., Los Angeles, Calif.
KOSHAL, KIDAR N., Washington, D. C.
LAMPL, WALTER O., New York, N. Y.
LANMON, C. P., 2ND, Houston, Texas
LOCKEY, WILLIAM R., Detroit, Mich.
LODGE, EDMUND A., Prescott, Ariz.
LOMASK, SAMUEL, New York, N. Y.
LOWELL, EUGENE A., Peoria, Ill.
LUNSFORD, GEORGE W., Freeport, Texas
MANN, JOSEPH E., Oak Ridge, Tenn.
MANN, LOUIS B., Lafayette, La.
MARINO-CERRATO, VINCENZO, Pompei, Napoli, Italy
MASSEN, ARMAND, Staten Island, N. Y.
MAUTZ, FERDINAND F., San Francisco, Calif.
MCBRIAN, RAY, Denver, Colo.
MEADOWS, ROSCOE, JR., Warwick, Va.
MORANG, RALPH E., JR., Oak Ridge, Tenn.
NEERKEN, RICHARD F., Los Angeles, Calif.
NEIL, DONALD R., Short Hills, N. J.
NICKELSON, THOMAS S., JR., Detroit, Mich.
O'BRIEN, PAUL D., Los Alamos, N. Mex.
O'CONNOR, BERNARD E., Highland Park, Mich.
O'DONNELL, EUGENE L., Pittsburgh, Pa.
PETERSON, JOHN W., JR., Drexel Hill, Pa.
PYE, ARCHIBALD C., Oakland, Calif.
RAPPELYEA, ERDMAN W., Milltown, N. J.
READ, SANFORD V., Plainfield, N. J.
REISINGER, ROWLAND H., Baltimore, Md.
ROBBINS, JAMES C., Kansas City, Mo.
ROY, THEDFORD A., SR., Augusta, Ga.
SAFIER, IRVING, Pasadena, Calif.
SAKO, FUMIO F., Chicago, Ill.
SALIMBENE, RUSSELL, Canton, Ohio
SCREPETIS, DENNIS, Jersey City, N. J.
SEMBAR, CHESTER R., Pittsburgh, Pa.
STEVENS, WILLIAM E., Essexville, Mich.
STUBBLEFIELD, ROBERT L., Oyster Point, Va.
SULOWAY, NAOMI S., Lombard, Ill.
SWEETMAN, WILLIAM E., Cranford, N. J.
TAPPER, CHARLES E., Seattle, Wash.
THERIAULT, WILLIAM E., Montreal, P. Q., Can.
VANNAH, WILLIAM E., Foxboro, Mass.
VOLCKMAN, ERNEST A., Verona, N. J.
WAITE, DAVID P., Lynn, Mass.
WALKER, JAMES D., Winnetka, Ill.
WALTON, CHESTER L., JR., Alliance, Ohio
WEIDNER, CHARLES K., Beirut, Lebanese Republic
WENGER, THOMAS D., Muscatine, Iowa
WESCOAT, JAMES L., Roselle, N. J.
WHATLEY, WILLIAM J., Richmond, Va.

CHANGE IN GRADING

Transfers to Members and Associate

BAJC, VICTOR L., Fairport Harbor, Ohio
BELDECOS, NICHOLAS A., McKeesport, Pa.
BERGETHON, ODVARD M., Peterborough, N. H.
BOWEN, JOHN T., New York, N. Y.
BRADFORD, ALVA N., Penn Yan, N. Y.
CLARK, ALBERT G., Ballston Lake, N. Y.
DIETER, FREDERICK A., Louisville, Ky.
EATON, GEORGE C., Boston, Mass.
FRANK, WALLACE E., Kintnersville, Pa.
GROSS, ALBERT, Long Island City, N. Y.
HENDRICKSON, ROBERT L., Scotia, N. Y.
HORLANDER, LEO A., JR., Louisville, Ky.
JANDRISEVITS, PETER, Metuchen, N. J.
JUDSON, CHARLES J., Seattle, Wash.
KING, EARLE C., Evans City, Pa.
LOEBEL, FRED A., Milwaukee, Wis.
NEWELL, SIDNEY W., Oakland, Calif.
PAULSEN, EDWIN L., Snyder, N. Y.
SMITH, MARION L., Columbus, Ohio
STANTON, ARTHUR H., South Branch, N. J.
SUTTON, GEORGE P., Downey, Calif.
TARR, LEVI L., Bartlesville, Okla.
THURING, GEORGE L., State College, Pa.
WILSON, DONALD J., New York, N. Y.
WYATT, HAROLD W., Cincinnati, Ohio

Transfers from Student Member to Junior 40

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Mechanical Engineer, 33 years' experience in medium and heavy industry. Served five years apprenticeship. Has had 19 years' executive, five years' administrative, and four years' design experience. Excellent health. Seeks management or design-executive position. Will relocate. Me-991.

Development Engineer and Designer, 49, excellent background, 23 years' of diversified experience in design, material handling, and heavy machinery, special problems, ceramic machinery, etc. Seeks permanent position. Prefers West Coast, but no limitation. Available after 30 days' notice. Me-992.

Administrative Engineer, 36; BME; PE, N. Y. Plant and process design, construction, maintenance; experienced both chemical and process industries. Plant-site selection, investigations, reports for top management. Desires permanent location, family. Me-993.

Sales Engineer, 28, single, BME, Georgia Tech. Submarine officer, three years; examiner, U. S. Patent Office, three years. Registered Patent Agent. Licensed Marine Engineer (steam and diesel). Available Oct. 1, 1953. No preference to location. Me-994-537-D-10.

Mechanical Engineer, 31, BSME, married. Five and a half years' plant-engineering experience in mechanized cast-iron foundry and machine shop. Desires managerial or production-engineering position. Me-995.

Engineer, 29, married, veteran, BSME, master's in business administration; six years' mechanical-engineering experience. Desires permanent position in engineering and/or industrial management. Prefers Philadelphia, Pa., or New York City areas. Me-996.

Mechanical Engineer, 25, master's in business administration, two and a half years' diversified project experience including investigation and installation of new processes and equipment. Prefers position in evaluating plant expansions and capital expenditures, economic analysis, and supervision of installation. Me-997.

Mechanical Engineer, 24, BME, married; one year experience in time study. Desires position in production engineering with progressive concern offering opportunity for advancement into industrial management. Prefers New York metropolitan area. Me-998.

Mechanical Engineer, 34, BSME, single. Background in district sales service, new product promotion, technical reports, training schools on internal-combustion engines. Other experience well diversified. Desires responsible position. Immediate availability. Me-999.

Mechanical or Plant Engineer, 53, registered mechanical engineer, married. Twenty-nine years' experience in design and building of special production equipment; tool engineering; bulk material handling, processing, and storage; plant layout and maintenance; construction supervision. Available after September, 1953. Prefers southwestern area of U. S. Me-1-536-D-9.

Executive Engineer, 43, married, able administrator, 20 years' experience manufacturing heavy chemicals, petrochemicals, plastics, and detergents. A cost-conscious chemical and mechanical engineer with doctor of engineering science degree. Available in four weeks. Prefers Pacific Coast. Me-2-496-D-67.

Sales Engineer, 31, married, registered mechanical engineer in Pennsylvania; eight years' experience selling switchgear and electrical distribution equipment. Desires position with factory representative or agent on commission basis. Me-3.

[1] All men listed hold some form of ASME membership.

Positions Available

Mechanical Engineer, design engineering experience in machinery fields, for design work, customer contact, and sales engineering (*a*) in the field of die casting; (*b*) in the field of nonferrous extrusion. Upstate New York. Y-8864.

Machine-Shop Foreman to supervise machine-shop and plant maintenance. Should have knowledge of precision die work as company manufactures machines for special purposes. $6500–$8320. Northern N. J. Y-8888.

Industrial Engineer for company manufacturing men's shirts. Must be top-notch man and be well versed in time studies, motion study, piece rates, layouts, methods, analysis, etc. Must have had experience in men's sport shirts. $10,000, depending on applicant. South. Y-8902.

Engineers. (*a*) Industrial engineer for staff position with management firm specializing in foundry and machine-shop practices. Considerable traveling. $10,000. (*b*) Time-study engineer for staff position with above firm. $5200–$6500. Headquarters, New York, N. Y. Y-8906.

Senior Methods Analyst, 30–40, mechanical or industrial degree, about five to ten years' experience, for duties involving office methods, improvement, cost-reduction survey and installation, formulate standardization program. Some traveling. $8500–$10,000. New York, N. Y. Y-8912.

Power Engineer, 25–30, degree in mechanical or electrical engineering, up to five years' experience, to work in plant power-engineering group. Duties include operation of equipment, design of power facilities, and conservation of utilities, for chemical company. Salary open. Mid-Atlantic State. Y-8918.

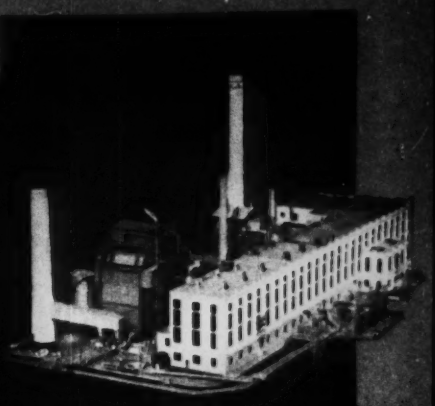
Mechanical Engineer, young, graduate, and eligible for registration in a few years. About two to four years' experience minimum desired on industrial building construction. Must be able to take on most of the engineering problems connected with industrial building work, including miscellaneous, mechanical, and structural problems encountered in designing of buildings and building services. About $5200. Prefer resident of Philadelphia, Pa., area. Y-8919.

Master Mechanic or Chief Tooling Engineer, 40–55, broad mechanical background in mass production of low-cost, precision, electromechanical products. Must understand design of blanking and draw dies, tooling of precision boring machines, cutting and form tools, jigs, and fixtures, etc. Will be responsible for tool design, tool engineering, purchase of tools, machinery and equipment procurement, design of special machinery, product process layout, etc. $12,000–$15,000. Upstate New York. Y-8922.

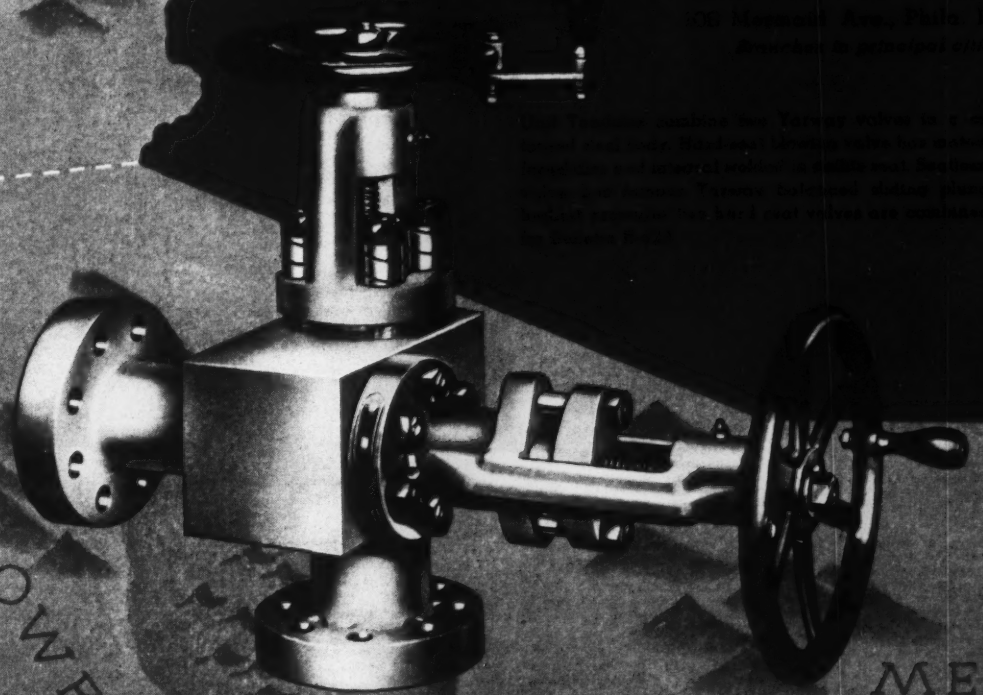
(*ASME News continued on page 768*)

EVADA

ALSO IN ARIZONA, IT'S YARWAY



YARWAY UNIT TANDEMS



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YARWAY SERVICE GOES ALL THE WAY....

Engineers. (*a*) Chief mechanical engineer, several years' supervisory experience in mechanical design in electronics or a closely associated industry. Mechanical or equivalent experience required, preferably at least ten years' experience. Up to $11,000. (*b*) Senior mechanical engineer, mechanical degree or equivalent experience, and at least five years' design work in electronics or closely associated industry. Up to $9500. Upstate New York. Y-8959.

Chief Plant Engineer, preferably under 45, to take complete charge of all maintenance and operation of three boiler plants, turbogenerator plant sewerage-treatment plant, water supply for food-processing plant. $8000–$10,000 in U. S. currency; company furnishes home, utilities, and automobile free, plus cost of living bonus of $400 a month. Philippines. F-8981.

Mechanical Designers familiar with ASME Unfired Pressure Vessel Codes. Any experience with concerns such as Foster Wheeler Corp. and The Babcock & Wilcox Co. desirable. Four months out of town in vicinity of Buffalo. Later will be located at main office in Newark, N. J. $6000–$7500, plus per diem and transportation while away from company headquarters. Y-8992.

Mechanical Engineer, 30–40, to supervise design and product development covering (*a*) valves, gears, and pneumatic equipment; (*b*) hydraulic equipment and fluid flowmeters. $8000–$12,000. Pa. Y-9002.

Senior Mechanical Engineers, at least eight years' experience in the mechanical-engineering field, including design drafting, testing and evaluation, report writing, manufacturing liaison, mathematical analysis, and project-supervision efforts. Should have BSME degree or equivalent in academic studies. Must be capable of producing design layouts, making proper selections of materials, and performing necessary stress calculations. Work includes the development and design of electromechanical equipment in the instrumentation field. Mass. Y-9006.

Industrial Engineer or Mechanical Engineer, recent graduate, for company manufacturing leather goods. Salary open, depending on qualifications. Must be draft exempt. New York, N. Y. Y-9010.

Mechanical or Aeronautical Engineer, 35–40, PhD, to head up mechanical-engineering and research department. Prefer industrial rather than academic experience as work will be industrial research. Will handle administrative duties for research projects in mechanical and aeronautical fields. No teaching work involved and position will carry professorship faculty in the school. $10,000–$11,000. South. Y-9011.

Chief Engineer, 42–47, mechanical graduate, at least ten years' design, development, and product-engineering experience covering machinery and equipment for printing, paper-products, and packaging industry. $12,000–$15,000. N. J. Y-9012.

Chief Engineer, mechanical graduate, at least five years' experience designing centrifugal pumps. Will supervise engineering department, of seven people, on design of centrifugal pumps up to 10 inches. $8500. Iowa. C-1127.

Piping Designer, 27–50, at least six years' experience in piping-layout design for refineries or process plants. Will design piping layouts for refineries. Moving expenses paid. $6000–$6600. Calif. C-1143.

Engineers. (*a*) Project engineer, 30–55, at least five years' experience in 2-cycle engine development or design of diesels. Knowledge of blower-type engines. Will head up project developing 2-cycle blower-type engines for a manufacturer. $8500–$10,000. Company will negotiate fee. (*b*) Designer, up to 55, at least five years' experience in diesel or engine design. Knowledge of blower-type engines. Will supervise squad designing 2-cycle blower-type engines for a manufacturer. $6000–$7200, plus overtime. Company will negotiate placement fee. Mich. C-1148.

Engineers. (*a*) Chief engineer, up to 45, at least five years' experience in concrete or asphalt-equipment design or development. Will supervise and direct design and development-plant engineering and entire engineering program in a small town, for a manufacturer of concrete equipment. Up to $15,000. (*b*) Designer, up to 40, at least two years' experience in design of special machinery and preferably in road equipment. Knowledge of concrete helpful. Will design concrete and asphalt equipment for a manufacturer of concrete equipment. Up to $9000. Employer will pay placement fees. New York State. C-1171.

Chief Manufacturing Engineer, 32–38, at least five years' experience in manufacturing small precision products. Knowledge of production equipment. Will be responsible for complete industrial-engineering program and tooling activities, for a manufacturer of precision parts. $8000. Company will negotiate placement fee. Ill. C-1189.

Engineers. (*a*) Welding engineer, up to 55, extensive knowledge of spot and resistance welding on sheet metal. Duties include processing and determining most economical methods in welded assemblies on sheet metal, some stainless steel, and other metals for manufacturer of major appliances. $6000–$8400. (*b*) Oil hydraulics engineer, mechanical preferred, up to 55, at least three years' experience in maintenance and installation of industrial-hydraulic oil systems. Will supervise upkeep and maintenance of entire hydraulic systems. Will also purchase new equipment as needed and supervise its installation for a manufacturer of major appliances. $6000–$7200. Ill. C-1192.

Obituaries

Otto Holm Anderson (1885–1953)

OTTO H. ANDERSON, president, National Steel Car Corp., Ltd., Hamilton, Ont., Can., who rose to be one of Canada's outstanding engineers in the railroad-car manufacturing industry, died June 28, 1953. Born, Horten, Norway, April 25, 1885. Parents, Nils and Louise (Holm) Anderson. Education, ME, Horten Technical College, 1904. Married Mabel Nielsen, 1916. Mem. ASME, 1923. Served the Society as a member, Executive Committee, Ontario Section, 1939–1941. Survived by wife and daughter, Dr. Irene Miale of Rochester, N. Y.

Edward Payson Bullard (1872–1953)

EDWARD P. BULLARD, chairman emeritus, board of directors, Bullard Machine Tool Co., Bridgeport, Conn., died June 26, 1953. Born, Columbus, Ohio, July 10, 1872. Parents, Edward P. and Alice M. (Camp) Bullard. Education, graduate, Williston Seminary, 1891; attended Amherst College, 1891–1892. Married Mary E. Deacon, 1897. Mem. ASME, 1913; Fellow ASME, 1948. He obtained more than 60 patents on devices used in the machine-tool industry. In 1920 he received the Howard N. Potts Gold Medal of The Franklin Institute of Pennsylvania for the development of an automatic machine tool called the Mult-Au-Matic. He received The American Society of Mechanical Engineers Medal in 1937 for outstanding leadership in the development of station-type machine tools; and in 1941, he received the NAM citation for Modern Pioneering. More than 40 years ago, with the assistance of E. H. Havens, of Bridgeport, and others, he set up a school in Bridgeport for free industrial education, now called the Bullard-Havens Technical School. Survived by a son, E. P. Bullard, 3rd; an adopted son, David Bullard; two daughters, Mrs. Thomas Wilbur and Miss Alice Bullard; and a brother, Joseph W. C. Bullard.

Clifford Francis Colomb (1897–1953?)

CLIFFORD F. COLOMB, sales engineer, Truscon Steel Division, Republic Steel Corp., New Orleans, La., died several months ago according to a report recently received by the Society. Born, New Orleans, La., May 6, 1897. Parents, Fredreck J. and Helène (Desmere) Colomb. Education, BS(ME), Louisiana State University, 1919. Married Ruth Railey, 1923; daughter, Ruth Rose. Mem. ASME, 1941.

Loyd Paine DuMond (1885–1953)

LOYD P. DUMOND, retired executive vice-president and member of the board, W. R. Roach & Co., now owned by Stokely Foods, Inc., Croswell, Mich., died May 12, 1953. Born, Arcade, N. Y., Jan. 8, 1885. Parents, William F. and Ella G. (Paine) DuMond. Education, high-school graduate; attended Mechanics Institute. Married Edith Kitchen, 1912. Assoc. ASME, 1938. Active in civic affairs, he served three terms as Mayor of Croswell, Mich. Survived by wife; a son, Brian V. DuMond, Unadilla, N. Y.; a sister, Neva; a nephew, Edward Bernard, Grand Rapids, Mich.; and five grandchildren.

Walter Stevenson Finlay, Jr. (1882–1953)

WALTER S. FINLAY, JR., executive vice-president and director, J. G. White Engineering Corp. New York, N. Y., died June 17, 1953. Born Hoboken, N. J., Aug. 18, 1882. Parents, Walter S. and Amy G. (Ketcham) Finlay. Education, ME, Cornell University, 1904. Married Jean Falconer Perkins, 1911 (deceased). Mem. ASME, 1916; Fellow ASME, 1936. He served the Society as chairman, Metropolitan Section; Manager, 1922; and vice-president, 1922–1924; Committee on Development, 1938; War Production Committee, 1943–1945. He was a Fellow AIEE; member, The Engineering Foundation; United Engineering Society; American Engineering Council; and many others. Author of several technical papers on power stations, construction, and operation published in scientific and professional journals. While with the J. G. White Corp. he directed engineering and consulting projects in Iran, China, Formosa, and Indonesia. He was a consultant to the United States Atomic Energy Commission. Survived by a daughter, Mrs. John N. Tracy, Glen Cove, L. I.; and three sons, Walter S., 3rd, Louisville, Ky.; Henry P. and John F., both of New Rochelle and New York, N. Y.

Stephen Waldo Jessop (1898–1953?)

STEPHEN W. JESSOP, chief estimator, Jervis B. Webb Co., Detroit, Mich., died some time ago according to a report recently received by the Society. Born, Detroit, Mich., Feb. 11, 1898. Education, BS(CE), University of Texas, 1921. Mem. ASME, 1950. Author of several papers on horsepower for overhead chain conveyers.

Spencer Ainsworth Jones (1890–1953)

SPENCER A. JONES, consultant on marketing of engineering products, Palo Alto, Calif., died June 2, 1953. Born, Belleville, N. J., May 19, 1890. Parents, Charles G. and Maude (Ainsworth) Jones. Education, 3 years, Princeton University; 1 year, Case School of Applied Science. Married Helen Summer, 1914 (died 1939); children, Lieut. William B. Jones, 1st, (killed in action, USAF, 1944); Richard C.; Margaret H. (Mrs. D. K.) Sick; Capt. Spencer A. Jones, Jr. Married 2nd, Ruth Carlberg, 1939; children, Carlberg and William B. Jones, 2nd. Mem. ASME, 1944.

Henry Bartels Lange (1885–1953)

HENRY B. LANGE, partner, Henry B. Lange & Co., industrial and marketing engineers, Los Angeles, Calif., died June 5, 1953. Parents, John D. and Alvina (Bartels) Lange. Education ME, Stevens Institute of Technology, 1907. Married Edna C. Johnson; children, Edna J. and J. Conradi. Mem. ASME, 1930. Survived by wife, a daughter, Edna (Mrs. W. W. Price, Jr.); and two grandchildren, Westcott W. Price, 3rd, and Lorinda L. Price.

Oscar Adolph Leutwiler (1877–1953)

OSCAR A. LEUTWILER, professor emeritus, head of mechanical-engineering department from 1934 to 1945, University of Illinois, Urbana, died in Batesville, Ark., May 31, 1953. Born, Highland, Ill., Feb. 16, 1877. Parents, Adolph and Selina (Seeger) Leutwiler. Education, BS(ME), University of Illinois, 1899; ME, 1900. Married Elsie V. Kaeser, 1901; children, Lester G., Kathryn E. He was the author of several textbooks on machines and power-plant design which are widely used in colleges and universities here and abroad. The titles are as follows: Elementary Machine Design, 1906; Mechanics of Machinery, Part 1, 1907; Part 2, 1908; Notes on Power-Plant Design, 1913, rewritten and enlarged, 1947; Elements of Machine Design, 1917; and Problems of Machine Design, 1923. Jun. ASME, 1905; Mem. ASME, 1912; Hon. Mem. ASME, 1948.

Charles Fredrick Markfelder (1876–1953)

CHARLES F. MARKFELDER, research engineer, Fidelity and Casualty Co. of New York, died June 12, 1953. Born, New York, N. Y., Feb. 15, 1876. Parents, Adam and Barbara (Koehler) Markfelder. Education, graduate, Pratt Institute, 1899. Married Rebecca Duffy, 1915. Assoc-Mem. ASME, 1924; Mem. ASME, 1931. Survived by wife; two brothers, Arthur, Joseph; and two sisters, Mrs. Peter Eckert, Mrs. Frances Herman.

Paul Baldinger Messenger (1918–1953)

PAUL B. MESSENGER, mechanical engineer, Marion Power Shovel Co., Marion, Ohio, whose home was in Albuquerque, N. Mex., was killed in an automobile accident, March 16, 1953. Born, Marion, Ohio, May 17, 1918. Education, BS(ME), Ohio Northern University, 1941. From June, 1941, to December, 1945, he served as engineering officer, Army Air Force Service at EAAB, Enid, Okla. At the completion of his service, he was placed on inactive duty with the rank of major, AFR. Jun. ASME, 1941; Mem. ASME, 1951. Survived by his wife, Jane; two sons, and a daughter.

Spencer Miller, Sr. (1859–1953)

SPENCER MILLER, SR., who perfected the overhead cableway system used in construction of the

(*ASME News continued on page 770*)

here's why

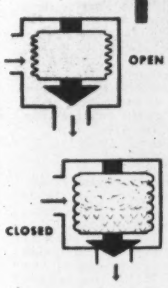
they selected 4 different types of steam traps for 4 different applications

CONDITIONS under which steam traps must operate vary widely, but there is for every service one type that gives maximum efficiency.

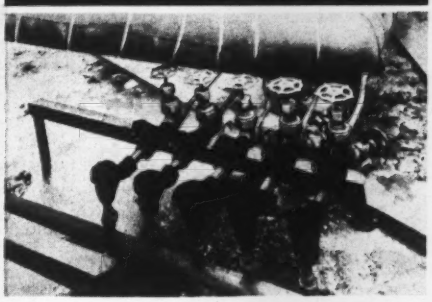
Sarco makes the 4 distinctly different TYPES of steam traps shown below. Therefore, Sarco can give you *impartial* advice on the best choice for your particular installation.

For each of the 4 jobs listed below, the users selected four different TYPES of Sarco traps.

CASE NO. 1



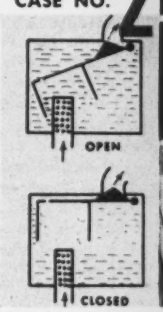
Draining outside tracer lines in an oil refinery in New Jersey



Type of traps installed: Sarco No. 9 thermostatic traps.

Why selected: Being thermostatic, they are steam misers. Can't freeze, being wide open when cold. Easy to maintain since only the bellows moves. Small, light and easy to install. Self-adjusting for different pressures.

CASE NO. 2

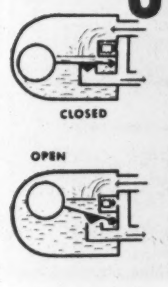


Draining platens of compression plastic presses

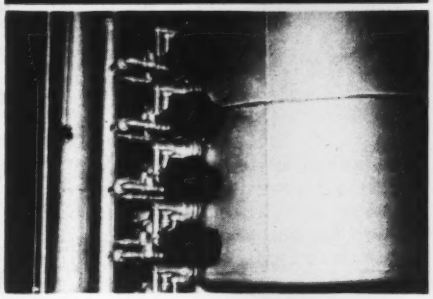
Type of traps installed: 100 Sarco Inverted Bucket traps in service for 17 years.

Why selected: Press platens have small horizontal steam spaces; the intermittent blast discharge of these Sarco traps scours the heating surface. Built-in strainer cuts maintenance costs.

CASE NO. 3



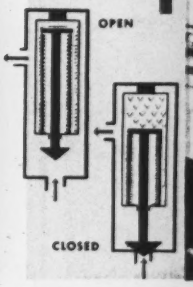
Draining heating coils of a milk evaporator



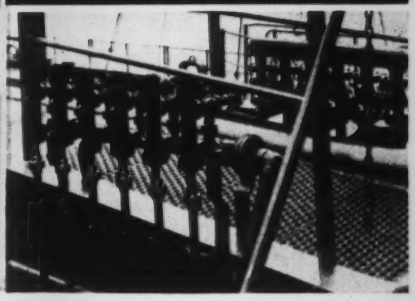
Type of trap installed: Sarco Float-Thermostatic Trap.

Why selected: Heating surfaces of the coils must be kept full of live steam — this Sarco trap discharges condensate as it collects. Can't airbind because the integral thermostatic vent gets rid of air, regardless of operating steam pressure and temperature. As shown in sketch 3 above, this vent does *not* depend upon the discharge of condensate.

CASE NO. 4



Draining heating coils on an oil tanker



Type of traps installed: Sarco LIQUID EXPANSION traps No. 871.

Why selected: Traps on tankers are exposed to freezing weather and vibration. Sarco's No. 871 traps can't freeze; resist vibration, water-hammer, pressure pulsations and superheat. These traps discharge condensate at adjustable temperatures below 212°F., permitting use of some of the condensate's sensible heat.

Write today for Bulletin No. 145-A: *Selecting the Right TYPE Steam Trap.* Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Represented in principal cities. Sarco Canada Ltd., Toronto 8, Ontario.

408

SARCO saves steam

improves product quality and output

Gatun Locks, Panama Canal, and extensively applied in construction of the Hoover Dam and other dams, died June 16, 1953, at Fort Myers, Fla. He also invented an overhead log-skidding system now in general use in lumber camps; a marine cableway for transshipping fuel under headway at sea, adopted by U. S. Navy; electric automatic tension towing engine; and a marine breeches buoy for transferring passengers from one ship to another. Some years ago, while making his home in South Orange, N. J., he was instrumental in establishing New Jersey's first mosquito-extermination agency. His many contributions both to engineering and civic betterment won for him several awards and honors. Born, Waukegan, Ill, April 25, 1859. Parents, Samuel F. and Charlotte (Howe) Miller. Education, BS(ME), Worcester Polytechnic Institute, 1879; hon. DE, 1928. Married Hattie M. Ruggles 1885; children, Marguerite (Mrs. P. E. Grannis), Spencer, Jr., Helen (Mrs. Aurelio Giorni). Married 2nd, Mrs. L. MacD. Sleeth, 1931. Mem. ASME, 1888; Fellow ASME, 1937. He served the Society as Manager, 1914–1917; Vice-President, 1917–1919. He was the author of several technical papers which were presented before engineering societies and published in professional journals. Survived by his son and two daughters.

William Arthur Fraser Millinger (1890–1953)

WILLIAM A. F. MILLINGER, mechanical, civil engineer, owner of firm, Engineering Project Services, Los Angeles, Calif., died May 30, 1953. Born, Aberdeen, Scotland, June 16, 1890. Parents, William and Jessie (Fraser) Millinger. Education, public school, England; West of Scotland Technical College, 1912. Married Margaret Simpson, 1913. Naturalized U. S. citizen, Bridgeport, Conn., September, 1918. He developed the Circu-Lectric space heater and the fuel oil carburetor. He received the Lincoln Arc Welding Foundation Award in 1942. He was the author of several technical papers on military airplane maintenance and inspection, intermediary air depots, and the like. Jun. ASME, 1918; Assoc-Mem. ASME, 1919; Mem. ASME, 1930. Survived by wife.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print **Check mailing address**

Name ..... (Last, First, Middle)

Home address ..... (Street, City, Zone, State) ☐

Name of employer .....

Address of employer ..... (Street, City, Zone, State) ☐

Product or service of company .....

Title of position held .....

Nature of work done .....

Please register me in three Professional Divisions as checked:

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ V—Gas Turbine Power
☐ D—Materials Handling	☐ M—Production Engineering	☐ W—Wood Industries
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ Y—Rubber & Plastics
☐ F—Fuels	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ R—Railroad	

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William Enoch Moore (1869–1952)

WILLIAM E. MOORE, president, W. E. Moore & Co., Engineers, Pittsburgh, Pa., died last fall according to a report recently received by the Society. Born, Boyd, N. C., June 11, 1869. Parents, James W. and Emily (Branson) Moore. Education, EE and ME, Trinity College (now Duke University). Married Grace Danley, 1922; daughter, Grace D. Mem. ASME, 1903. He served on the Steam Power Committee of the Society. He invented electric water works special governors, electric furnaces, electrode regulators; held more than 100 U. S. and foreign patents; and was author of technical papers covering his work.

James Henry Morris (1883–1953)

JAMES H. MORRIS, design engineer, Urban, Smyth & Warren, North Richland, Wash., died March 3, 1953. Born, Billings, Mo., July 17, 1883. Education, 4 years, general apprenticeship in mechanics and mechanical design; 5 years, home study (tutored by graduate engineers) in steam and hydraulics. Mem. ASME, 1947. He designed equipment for special use in the installation, test, and operation of machinery used on U. S. Navy destroyers and in the construction of those destroyers. Survived by wife.

Stuart Nixon (1897–1953)

STUART NIXON, research engineer, Sealed Power Corp., Muskegon, Mich., died June 9, 1953. Born, Boston, Mass., Oct. 14, 1897. Education, BS, Massachusetts Institute of Technology, 1921. Married Annette M. Peterson, 1941. In 1938 he developed and patented a spring-expanding device for piston rings, which is considered one of the more important improvements in the ring-manufacturing process. Mem. ASME, 1944. He had been extremely active in the Oil and Gas Power Division's activities. He was the author of many papers on piston-ring and piston engineering for internal-combustion engines. Survived by wife; two children, John, Margaret; two brothers, John, Detroit, Mich.; David, Hartford, Conn.; and two sisters, Mrs. D. B. Ward, Detroit; Jessica Nixon, Cleveland, Ohio.

George William Rink (1875–1953)

GEORGE W. RINK, retired mechanical engineer, Reading Co., died May 29, 1953. Born, New York, N. Y., Sept. 4, 1875. Parents, Jacob and Margaret (Rohn) Rink. Education, BS, The Cooper Union, 1897; ME, 1906. Married Bertha W. Schuler, 1915; children, Howard E., Robert W. Mem. ASME, 1907. He served the Society as chairman, Plainfield Section; vice-chairman, Railroad Division. He was the author of many papers on railroad engineering and held several U. S. patents on devices pertaining to railroad engineering.

Benjamin William Sprau (1888–1953)

BENJAMIN W. SPRAU, assistant sales manager, Erie City Iron Works, Erie, Pa., died June 6, 1953. Born, Erie, Pa., Oct. 1, 1888. Education, BS(ME), University of Michigan, 1911. Mem. ASME, 1938.

Robert McElfresh Tatum (1923–1953)

ROBERT McE. TATUM, naval intelligence officer, LTJG U. S. Navy, USS Mt. McKinley, and his wife were killed in an automobile accident near Albuquerque, N. Mex., Feb. 10, 1953. Born, Berwind, Colo., Nov. 3, 1923. Parents, Julian P. and Myrtle (McElfresh) Tatum. Education, AA, Trinidad State Junior College, 1943; BS, U. S. Naval Academy, 1948; attended University of Minnesota and Yale University after serving in Air Force. Married Anne C. Weiser, 1951. He received Commendation Ribbon and citation from Secretary of U. S. Navy for service with American Forces in Korean waters. Jun. ASME, 1948. He is survived by mother and brother, Julian P. Tatum, Jr., both of Colorado Springs, Colo.

Albert Jay Townsend (1892–1953)

ALBERT J. TOWNSEND, field engineer, valves and fittings-engineering department, Crane Co., Chicago, Ill., died June 3, 1953. Born, Syracuse, N. Y., Aug. 4, 1892. Education, ME, University of Michigan, 1915. Mem. ASME, 1940. He held a number of patents on locomotive designs.

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Smooth, quiet, *"purring"* performance is characteristic of the Fractional Horsepower Gearing we make! And no matter *what* the device or *how* the power is transmitted, you can depend upon these better Small Gears to give greater satisfaction and longer life to the product. G. S. have the distinction of over 30 years experience in the design and manufacture of Fractional Horsepower Gearing *exclusively!* Methods and machines have been perfected to a degree of efficiency and economy often considered impossible! Each Gear, in a production run of *thousands,* is precision produced to remarkable standards of accuracy and UNIFORMITY. You too can profit from the *consistently* finer quality of G. S. Gearing. Decide *now,* to let our skilled engineers and production craftsmen help you. Will you phone or write us today?

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JENKINS PRACTICAL PIPING LAYOUTS

68

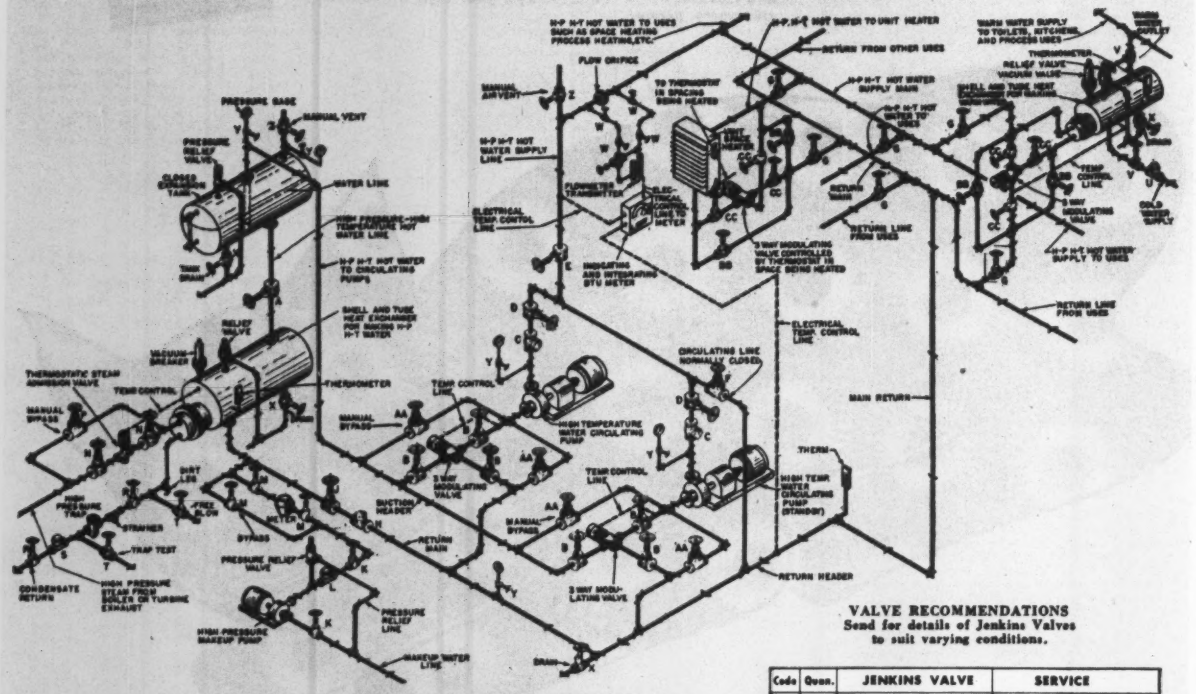

Diagram by Huxley Madeheim, Consulting Engineer
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VALVE RECOMMENDATIONS
Send for details of Jenkins Valves to suit varying conditions.

Code	Quan.	JENKINS VALVE	SERVICE
A	1	Fig. 204 IBBM Gate	HP-HT Hot Water Shutoff
B	6	Fig. 204 IBBM Gate	3 Way Valve Shutoff
C	2	Fig. 339-R IBBM Swing Check	Prevent Backflow
D	2	Fig. 204 IBBM Gate	Pump Discharge Shutoff
E	1	Fig. 204 IBBM Gate	Supply Line Shutoff
F	1	Fig. 923 IBBM Globe	Circulating Line Shutoff
G	6	Fig. 280 Bronze Gate	Branch Shutoffs
H	1	Fig. 339-R IBBM Swing Check	Prevent Backflow
J	1	Fig. 204 IBBM Gate	Return Main Shutoff
K	2	Fig. 280-U Bronze Gate	Makeup Pump Shutoff
L	1	Fig. 962 Bronze Swing Check	Prevent Backflow
M	3	Fig. 280 Bronze Gate	Makeup Meter Shutoff
N	2	Fig. 1010 Cast Steel Gate	Thermostatic Valve Shutoff
P	1	Fig. 1042 Cast Steel Globe	ThermostaticValveBypass
R	2	Fig. 280-UN Bronze Gate	Condensate Line Shutoff
S	1	Fig. 962 Bronze Swing Check	Prevent Condensate Backflow
T	2	Fig. 976-A Bronze Globe	Trap Test, Free Blow
U	1	Fig. 352 Bronze Swing Check	Prevent Backflow
V	2	Fig. 47-U Bronze Gate	Cold Water Shutoff
W	4	Fig. 703 Bronze Globe	Flow Meter Pressure Taps
X	4	Fig. 976-A Bronze Globe	Drain Lines
Y	5	Fig. 703 Bronze Globe	Pressure Gage Control
Z	2	Fig. 976-A Bronze Globe	Air Vents
AA	4	Fig. 923 IBBM Globe	3 Way Valve Bypass
BB	4	Fig. 976-A Bronze Globe	3 Way Valve Bypass
CC	6	Fig. 280 Bronze Gate	3 Way Valve Shutoff

How to plan a HIGH PRESSURE-HIGH TEMPERATURE HOT WATER PIPING SYSTEM

For efficient space and water heating — and for numerous processing needs as well — a high pressure-high temperature system offers several distinct advantages over a steam system.

Often operated at pressures up to 215 psi, with a corresponding temperature of 388°F, a HP-HT system of this type eliminates the need for pitch, drainage, or traps and provides a greater amount of heat transmission for a given pipe size. Moreover, it requires no feed-water treatment and, when used for processing services, eliminates large pressure drops due to sudden load conditions.

The hot water is generated in a shell and tube heat exchanger by means of high pressure steam from either turbine extraction or exhaust. Unit heaters on the HP-HT lines provide for space heating requirements and a shell and tube heat exchanger supplies warm water for lavatories, kitchens, and processing which requires moderate temperatures. When used with accumulators, this system eliminates the need for taking additional steam directly from the steam generating source and, thus, provides a better plant heat balance.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 68.

Jenkins Bros

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT

New Materials Handling Method Cuts Costs

The development of a new type of gripper arms for lift trucks has been announced by Shell Oil Co.

The device is hailed as the key to the handling of materials without using the customary wooden pallet. The new handling method differs from conventional fork-lift truck operations in that gripper arms grasp loads from the sides so that no bottom support is needed.

The new gripper arms were developed to cut Shell's distribution expenses. Elimination of wooden pallets would save Shell between $250,000 and $750,000 a year for replacement and upkeep alone, according to the company. Pallets also waste freight and warehouse space and labor for manhandling.

In its initial study of the whole distribution problem, Shell concluded that palletless handling was preferable. But tests proved existing gripper arms unsatisfactory for several reasons. Not only did they have to be changed for different types of loads, but the thickness of the arms necessitated leaving large gaps between loads, thereby wasting warehouse and freight space.

Shell engineering and distribution experts say their versatile new gripper arms attachment solves these problems. They predict substantial savings in distribution costs through use of the attachments which are being installed in Shell depots as fast as they can be produced. The attachments are expected to be on the market for general use within several months. They will be produced by manufacturers licensed by Shell.

Development of the arms started several years ago as a project of Shell's marketing operations department. The Elwell-Parker Electric Company of Cleveland, Ohio, constructed the attachment, through several phases, under Shell's guidance. Shell's major use of the new attachment is in handling drums and packages. The same set of arms can handle both types of loads, giving the device versatility.

Rate-of-Rise Thermostat

A rate-of-rise thermostat designed to control the rate of heating and prevent hazardous temperature overshoots in fast warm-up systems has been developed by Fenwal Inc., Ashland, Mass. The unit, when used in any type of heated system, controls the rate of heat output during the warm-up period and aids substantially in bringing the system up to the desired temperature without danger of over-shoot. Rate-of-rise controls of this type are also useful in monitoring processes in which rate of heating must be controlled or in which temperature overshoots from a rapid heating cycle must be prevented.

The rate-of-rise thermostat unit may be used either with standard temperature controls or as a separate safety control. When used in series with a temperature controller, the rate-of-rise unit brings the system up to temperature from a "cold" start, at any rate desired, without temperature overshoot and oscillation around the control temperature. After the controlled warm-up period, the standard temperature controller takes over and the rate-of-rise unit becomes a safety check.

The rate-of-rise unit may also be used separately as a safety limit switch to shut down a process or machine where excessive rates of temperature rise indicate an abnormal, hazardous condition.

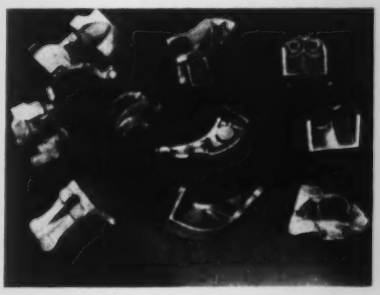
The Fenwal rate-of-rise Thermoswitch is adjustable to control any heating rate between 10 and 100 deg F per min. When the heating rate exceeds the pre-set limit, the switch contacts inside the unit open and interrupt the heating cycle temporarily. After the heating rate falls off to a safe level, the contacts once again close and the heating cycle resumes, unless a circuit breaker arrangement is used.

The unit can be used in any ambient temperature between −100 F and +550 F, and claims excellent shock and vibration resistance. The unit is hermetically sealed.

Both the outer shell, which houses the contact assembly, and the exterior electrical terminals are made of stainless steel. The cartridge extends 3 3/4 in. below the mounting flange, and overall length is approximately 4 3/4 in. The unit weighs less than 1/4 lb, and is 5/8 in. in diameter. Electrical rating is 5 amps at 115 v alternating current, or 2 amps at 28 volts direct current. Further information can be obtained from Fenwal Inc., Ashland, Mass.

Aluminum Castings

The aluminum sand castings shown, by Oberdorfer Foundries, Syracuse, N. Y., lighten chassis weight in Mack Truck's newest tractors. One thousand pounds have been eliminated in these models with no sacrifice in strength, according to Oberdorfer, mainly through use of lighter metals. Parts cast by Orberdorfer include brackets for steering gear, engine, springs, air chamber, breaker spider, and numerous other mounting and supporting sections.



Because of increasingly strict limits on the gross weight of trucks, and the fact that every pound saved in the vehicle can be added to the payload, Oberdorfer has been producing lightweight castings for a growing number of manufacturers in the automotive, truck, and diesel field, the company explains. The foundry is also a prime producer of parts for aircraft engines, portable power tools, electrical appliances, and numerous other products where weight-saving is an important factor.

Sprocket Wheels With Taper Lock Bushings

A new line of roller chain sprocket wheels with taper lock bushings has been announced by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. Without reboring, these stock sizes of sprocket wheels can be securely mounted on a shaft, equivalent to a shrink fit, according to the manufacturer.

Set screws force and hold the split tapered bushing in the tapered bore of the sprocket wheel, causing it to lock tightly onto the shaft. The full length of the bushing supports the sprocket on the shaft.

Link-Belt sprocket wheels with taper lock bushings for 1/2-, 5/8-, 3/4-, 1-, and 1 1/4-in. pitch single-width chains are now available from Link-Belt distributors and factory branch stores.

A 16-page Book No. 2449, published by Link-Belt Co., gives information about these sprocket wheels. Illustrations show how they are installed and removed. Tables list stock sizes of wheels and bushings. Copies of Book 2449 will be sent on request.

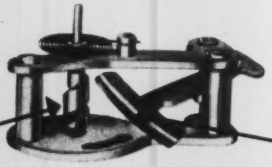
Try a HELICOID. Find the toughest spot you have for a gage. Let the HELICOID prove itself. Let it show you how much these quality gages can save you, especially in maintenance, as the standard gage throughout your plant.

HELICOID has no gears to wear out!

Flutter, extreme surges, rapid pulsations—these break down ordinary gages but they can't hurt a HELICOID because 1) the HELICOID has no gears, no teeth to wear out; 2) the cam releases from roller at maximum dial graduation (it resets automatically, instantly). See illustration below.

Many Sizes, Many Styles

You can get HELICOID Gages for pressure, vacuum, or compound service—in all pressure ranges; white, black or radiant faces; wall, stem, flush, and panel mountings, for flangeless cases. See your distributor today or write for **catalog G-2.**



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Oxygen and Combustibles Analyzer

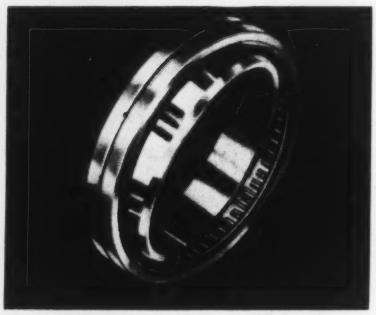
The Bailey Meter Co. has developed a combination oxygen and combustibles analyzer. Analyses of per cent of oxygen, an index of excess air, and per cent combustible, an index of fuel-air mixing performance, are offered for the first time in a single, compact unit, Bailey engineers state.

Minimum range is 0–5 per cent; maximum range, 0–25 per cent. Compressed air and hydrogen are used for catalytic combustion. Noble metal filaments with thermal conductivity compensators are part of null balance bridges. Accuracy within ±0.25 per cent by volume of oxygen and combustibles contents in sample is claimed.

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio, will send Product Specification E65-1 on request.

High-Capacity Roller Bearing

Developed primarily for high-speed aircraft, this self-aligning, torque-tube-type, double-row roller bearing is said to provide full freedom of rotation under all conditions of misalignment resulting from mounting inaccuracies and the usual flexing of airframe structural members during flight.



The bearing is factory-lubricated and equipped with positive seals. Other advantages claimed include simplicity and compactness which produce a high-capacity, light-weight bearing of fewer parts with minimum cross-section dimensions.

The bearing, designated as the DP Series, is a product of Shafer Bearing Div. of Chain Belt Co., Downers Grove, Ill., manufacturers of both industrial and aircraft self-aligning roller bearings.

Package Water Conditioner

Permutit's Package Water Conditioning Plant, a versatile and self-contained unit, designed to chlorinate, coagulate, clarify, filter, neutralize, de-alkalize and soften raw water supplies, is described and illustrated in a new eight-page bulletin, No. 3869.

Prepared by The Permutit Co., New York 36, N. Y., it lists the component parts of the complete water conditioner, details the principles of operation, gives ratings, capacities and sizes, and illustrates some typical installations.

The plants have many applications and can be used to condition water supplies for small municipalities, real estate developments, plantations, ranches and farms, lumber and logging establishments, factories, power stations, railroad shops, boiler plants, mills, canneries, bottlers, breweries, laundries, ice plants, dairies, etc.

Man-Trolley Increases Capacity of Ore Bridge

Continuous expansion of pig iron production facilities at the Neville Island plant of Pittsburgh Coke & Chemical Co. created a serious problem for the firm's materials-handling bridge, which supplies iron ore, coke, and limestone to the blast furnaces.

Built originally in 1929 by Dravo Corp., Neville Island, Pittsburgh 25, Pa., the ore bridge was designed to serve only one 19-ft-hearth blast-furnace as well as the company's cement plant. It was operated around-the-clock, seven days a week. In 1942, Pittsburgh Coke enlarged the blast furnace to a 22-ft hearth and the bridge was "hard put" to handle the resulting increase in raw materials supply.

The problem became acute at the beginning of 1953 when a new 22-ft-hearth blast furnace went into production, and the company's daily output of 800 tons of merchant pig iron was doubled. This forced the bridge to handle some 5600 tons a day of raw materials for the blast furnaces alone.

While a new ore bridge seemingly would have been the solution to the problem, the time necessary to construct one and the sizable investment it would require led the company to investigate other possibilities. They found the answer to be a new lightweight man trolley, designed and built by Dravo Corp. The entire project of constructing and erecting the new trolley and bucket cost only one-eighth the estimated expense of building a new bridge to achieve the same increase in materials-handling capacity.

The old trolley operated on a 60-sec free digging cycle with a five-ton bucket, providing a rating of 300 tons per hr. The new one operates on a 50-sec cycle with an 8½-ton bucket and has a rated capacity of 620 tons per hr.

Additional storage space for raw materials was obtained by extending the length of the bridge runway from 900 to 1200 ft and deepening the stockpile area below the bridge. Installation of the new trolley on the 280-ft span bridge did not interfere with the plant's production because the operation required only 13 hr., under the supervision of Mr. Sheets. This time included removal of the old trolley.

Dravo Corporation engineers pointed out that installation of lightweight man trolleys on existing materials handling structures, still in good structural condition, is a practical way to step up the operating capacity of ore and coal bridges to meet growing production requirements of blast furnaces, coke ovens and similar facilities. In effect, the weight saved in the new trolley is put into a larger capcity bucket without increasing the overall load on the bridge.

Film Layout System

Repro-Templets Inc. of Oakmont, Allegheny Co., Pa., has announced a new line of Repro-Templets on film of over 10,000 standard machine tools and metal-working plant equipment items for plant layout uses.

The Templets are printed on 0.0075-in. acetate film, and represent the overall dimensions of the machine or piece of equipment; they show, in dotted lines, the floor contact base, and are identified with typeset lettering.

The Templets may be selected from a stock of over 10,000 items, both machine tools and plant equipment, and are available for immediate shipment at an average cost of 8 cents to 12 cents each, the manufacturer says. These Repro-Templets on film have been checked for accuracy by the manufacturers of the machines and equipment.

Gearmotors

Elliott Co., Crocker-Wheeler Div., Ampere, N. J., has introduced a line of gearmotors featuring a wide selection of compact, integral power units with single (780 to 280 rpm), double (230 to 45 rpm), or triple (37 to 7.5 rpm) speed reduction.

These units are available with any Crocker-Wheeler motor, a-c, squirrel-cage, wound rotor, d-c, or multi-speed, in open-protected, splash-proof, totally enclosed non-ventilated, totally enclosed fan-cooled, and explosion-proof closures. Frame sizes range from 1 to 150 hp. Mountings may be horizontal, ceiling, sidewall, or inclined. Also available is a complete integral power unit with the Crocker-Wheeler disk brake.

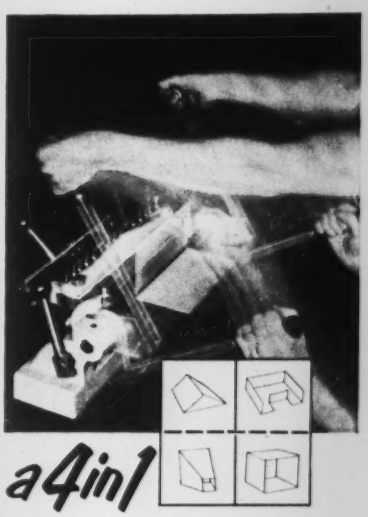
Further information is contained in Bulletin PB 18000-1, obtainable from the company.

Fork-Lift Trucks with Torque-Converter Drive

Clark Equipment Co., Battle Creek, Mich., has announced the production of Hydratork Drive, an automatic transmission that makes it possible to operate a gas-powered fork-lift truck with the same three controls used to operate an automobile: an accelerator, a brake pedal, and a forward-reverse selector lever located on the steering column. The design of the unit eliminates the need for a gear shift for high and low gears and a clutch and clutch pedal.

On the basis of field-test results, Clark reports that the Hydratork substantially increases the work capacity of gas-powered trucks with standard, or conventional, transmissions and, at the same time, reduces operating and maintenance costs.

The factory-installed unit, which costs $370.00, is currently being manufactured for Clark's Utilitruc line of fork-lift trucks in the 6000-7000-lb capacity range. The unit is not and will not be available for field installation.



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di-acro* BOX FINGER BRAKE

Accurately, Easily, Quickly Form and Duplicate a Wide Variety of Shapes in Metal as Heavy as 16 Gauge—Widths up to 24" —with Versatile Di-Acro Brakes.

A number of forming jobs can be done with the Di-Acro Box Finger Brake, by simply adjusting or changing the type of mounting bar on the contact surface. Di-Acro Finger Brake is:

- **Box and Pan Brake** — when equipped with a complete set of Box Fingers.
- **Open End Brake**—when Open End Finger is installed in place of Box Fingers.
- **Bar Folder** — when an Acute Angle Bar replaces the Box Finger Bar mounting.
- **Standard Brake** — when a Forming Bar is mounted for heavy operations.

Di-Acro Standard and Radius Brakes are also available. Ten models in all.

*pronounced Die-ack-ro

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Gives facts on Di-Acro Brakes and also both hand and power operated Di-Acro Benders, Notchers, Punch Presses, Rod Parters, Rollers and Shears. Mail your request today.

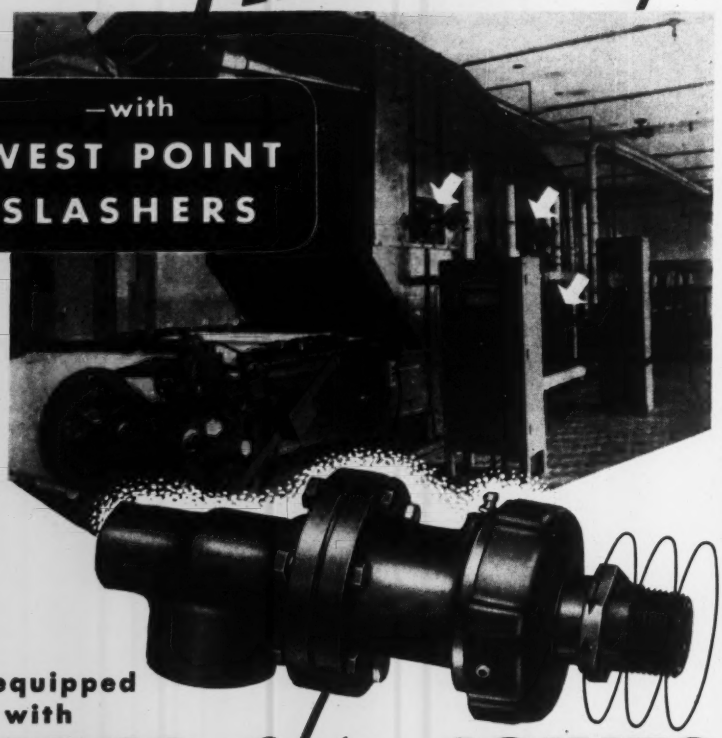
Creators of "Die-Less Duplicating"

O'NEIL-IRWIN MFG. CO.
308 Eighth Ave.
Lake City, Minn.

di-acro PRECISION METALWORKING MACHINES

OUTSTANDING PERFORMANCE

—with WEST POINT SLASHERS



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BARCO *Revolving* JOINTS

- Trouble-free Performance! Thanks to long lasting "CTR" V-Type Seal Rings—a Barco Development.
- Free-Floating, Low Torque Installations. Cuts Power Costs up to 50%.
- Unexcelled Ability to withstand Vibration and Hard Usage.
- Better Temperature Control where steam is used for heating rolls due to better circulation.
- Low Maintenance; No Adjusting. Holds seal running or standing.

THE name "West Point" stands for carefully engineered designs and faultless performance in textile mill slashers everywhere. With West Point, as with other leading manufacturers, one key factor in performance is the selection of Revolving Joints.

To provide *trouble-free* rotating connections for steam supply and condensate drainage, West Point Slashers are regularly equipped with Barco Revolving Joints—*as indicated in the above installation.*

Let us send you complete information about Barco's new *improved* Type IBR Revolving Joints for Textile Machine Dryers, Slashers, Dry Cans, Sanforizers. *Catalog 300 on request.*

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Automatic Dating Device on Time Recorders

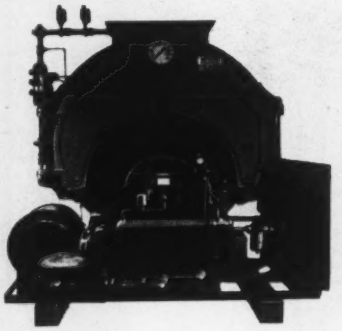
The Calculagraph Co. has announced a time- and labor-saving feature which is now standard equipment on all industrial model Calculagraphs. All printed elapsed-time records are now automatically dated by the machine.

Data and illustrated catalog, will be sent by the manufacturer, Calculagraph Co., Inc., Sussex St., Harrison, N. J.

Boiler-Burner Unit

The Kewanee-Ross Corp. and the Ray Oil Burner Co. jointly have announced the new Kewanee-Ray Boiler-Burner Unit for high- and low-pressure steam and for hot-water heating.

The new Kewanee-Ray Boiler-Burner Unit is being manufactured for high-pressure steam to produce 39 to 456 certified-output hp at 125 and 150 psi wp and for low-pressure 15-psi steam or 30-psi water in sizes to produce 1,313,000 to 15,300,000 Btu hourly.



The Kewanee-Ray Unit is designed for forced-draft operation with a new multi-stage secondary air control on the burner providing a constant-velocity air stream, to the combustion zone, with a high-turbulence, high-turn-down ratio and a high CO_2 content said to result in the utmost in combustion efficiency.

Further information can be obtained from either Kewanee-Ross Corp., Kewanee, Ill., or the Ray Oil Burner Co., San Francisco, Cal.

Waste Disposal

Many states and municipalities are regulated by ordinances which prohibit or limit the discharge of harmful wastes into sewer systems. Limiting such discharge may mean "bleeding" wastes into local sewerage at a predetermined maximum. When such is the case, the value of an automatic control system is evident.

Builders RCB Controller with a Pendulum Unit, Builders Sightflo Indicators, and Builders FCV check valves form a "package control system" that often meets the requirements. Systems featuring this type of control are already in use. Specific details and a flow diagram are contained in Application Memo No. 600-K2, available on request from Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.

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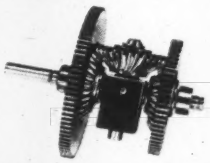
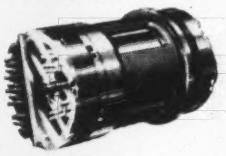
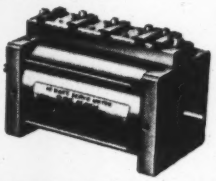
Ford Instrument Company makes the finest precision instruments and mechanisms for industry and the armed forces.



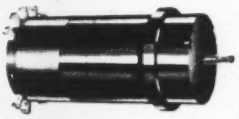
FORD MECHANICAL DIFFERENTIALS with single spider gear—available in 3/16," 1/4" and 5/16" shaft diameters—high accuracy, low friction.



FORD TELESYN UNITS are available in wide selection of sizes—proved precision accuracy, corrosion and fungus resistance mean better synchros when you specify Telesyn.



FORD SERVO MOTORS (60 and 400 cycles) for extremely low inertia and high frequency response. 1/5; ½; 1½; 2½; 5; 10-watt models in both low and high voltage, including magnetic amplifier controlled types.



FORD ELECTRICAL RESOLVERS available in sizes 23 and 31—interchangeability, temperature compensation −60°F to +160°F, highest accuracy, adaptability, 400 cycle frequency.

Ford Instrument also makes magnetic amplifier systems, computers, converters, mechanical integrators and other instruments and equipment. Write for more details.

11

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Division of The Sperry Corporation
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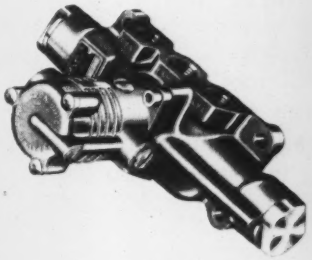
KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Solenoid Pilot-Operated Valves

Valvair Corp. has announced a line of solenoid pilot-operated air control valves. They are available for 3-way, 4-way, and 4-way 5-port (two-pressure) application in pipe sizes 1/4 in. through 1 in. All types and sizes are furnished either for foot mounting or sub-base manifold mounting in accordance with JIC specifications. A total of 30 new valves is included in this line to handle any type or size of application requirement. Field tests and laboratory breakdown tests have demonstrated that a minimum life expectancy of upwards of 20,000,000 cycles can be conservatively anticipated, the manufacturer states.



All parts are non-corrosive. The main valve body and, also, the sub-base is cast bronze. The spool is stainless steel, hard chrome-plated and polished to assure long life to the special Hycar O-ring seals. There is no spring in the main valve, since air from the pilot valve is utilized to reverse the spool in both directions. The spool is the one moving part of the main valve body, and all parts are accessible without disturbing the piping to the valve.

The pilot valve-control unit is manifolded with cap screws to the main valve body. An optional manual override is available for the pilot valve, which makes operation possible when electric current is off or when cylinder control set-ups are of importance. All parts of the pilot valve are totally enclosed to give the complete valve a dust-proof and splash-proof protection.

The solenoid coil is replaceable and is available in any alternating-current voltage and cycle, including all direct current requirements. The maximum current consumption at any voltage is only 10 w., assuring cool operation and long life at operating speeds as high as 600 cycles per minute. The solenoid can be held energized for any length of time without overheating and is applicable for constant or intermittent duty. Solenoid and pilot valve parts are accessible by simply removing three cap screws.

The exhaust port is common for both the pilot and main valve, being the next pipe size larger than the inlet and cylinder ports. Side and bottom port tappings are furnished as standard on all sub-base manifold types. Valves can be mounted in any position to facilitate original equipment design and add appearance to any type of equipment.

All models are for air pressure from 35 to 150 psi and for low-pressure oil hydraulic service. It is claimed that this is the most compact line of valves on the market which maintains full pipe orifice area through the valve. The 3/8-in. 4-way foot mounted valve is only 7 3/4 in. long by 4 3/4 in. high and 2-3/4 in.

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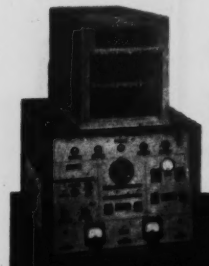

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HATHAWAY Type SC-16 OSCILLOGRAPH

The NEW and PHENOMENAL Hathaway Type SC-16 Oscillograph with 6 elements is *flat from 0 to 200,000 cycles per second, and its traces have a writing speed of 5 million inches per second.*

Fast transients and high-frequency phenomena can be accurately recorded.

Several types of continuous-drive record magazines are available for 6-inch sensitized paper and film, and for 35-mm film. Drum-type magazines, both small and large, are valuable for short high-speed records. 10-foot drum-type charts can be driven at 3000 RPM for a *chart speed of 6000 inches per second* when high resolution is needed.

Useful for strain recording to 100 Kilocycles.

Automatic Operation Initiate a transient with the oscillograph, or let the transient start the oscillograph.

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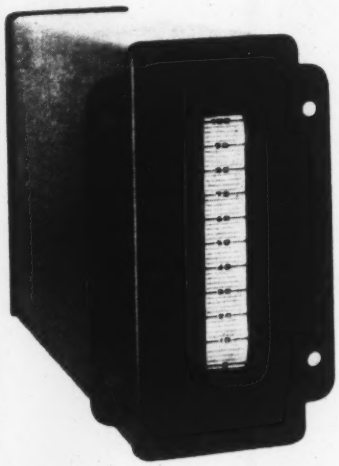
wide. Direct flow through the valve has been maintained to minimize pressure drop. The valve is designed and manufactured by Valvair Corp., 1009 Beardsley Ave., Akron 11, Ohio.

Ribbon-Type Indicator For Graphic Panels

A new ribbon-type indicating receiver for graphic panel use has been announced by the Foxboro Co., Foxboro, Mass. Added to the comapny's Consotrol line of instruments, the Model 50 Consotrol Indicator is especially suited to panel applications which require continuous indication of valve position or variables such as liquid level.



The indicator receives pneumatic measurements from a transmitter located at the process. This force is applied to a receiver bellows which, through a lever and stainless steel tape arrangement, rotates two drums. A brightly colored Nylon tape, wound on the drums, is thus drawn behind a glass pane on which scale graduations are printed.

The indicator scale measures 3/4 by 4 1/4 in. All component parts are mounted on a removable chassis and protected by a housing which is secured to the back of the panel. The complete mechanism can be removed from its housing for service without disturbing the scale, case, or panel. Zero, range, and damping adjustments are then accessible.

The instrument is available with single or dual indicating scales and can be adjusted for direct or reverse response to measurement, as desired. Alarm contacts of the mercury switch type are optionally provided to produce various combinations of warning signals, depending on process needs.

Boiler-Burner Unit

A pressurized boiler-burner unit has been developed for high- or low-pressure heating, power, and process steam. The unit, sold and serviced as a completely packaged plant, represents the work of two separate companies, Titusville Iron Works Co., which designed the boiler, and Iron Fireman Mfg. Co., which developed the burner system.

The new Titusville-Iron Fireman Boiler-Burner unit operates on oil, gas, or oil and

gas combination, with switching of fuels accomplished quickly. The unit is shipped completely assembled on steel skid, and is ready for operation as soon as fuel, water, steam, and electrical connections are made.

The boiler is of ASME Code construction throughout, and was designed with unusually large furnace volume to assure lower heat release, with proportional longer service life, the manufacturer declares. The tubes are arranged in staggered rows. Other boiler features announced include ample steam disengaging surface to insure dry steam, ample openings for ease of access and cleanability, davit flue-door suspension, and removable gas-tight rear cover plate.

The fully automatically controlled Iron Fireman Burner Unit has a turndown of 5 to 1, and will operate at over 80 per cent efficiency through its entire modulating range, burning either gas or oil. The fully automatic control center is alert to any possible change in boiler load or abnormal operating conditions, according to the maker. A volumetric oil control meters by volume the quantity of oil needed for varying loads, and an automatic oil-heating system keeps heavy oil at the correct temperature and viscosity.

The entire boiler-burner unit is sealed for operation at higher than atmospheric pressure. No induced draft fan or natural draft stack are required.

The Titusville-Iron Fireman Boiler-Burner Unit is supplied in two basic types, power units and heating boilers. The power units are built in a complete capacity range from 37 hp to 363 hp, at normal SBI rating, with certified output ratings from 56 hp to 545 hp. The heating boilers are built in sizes from 4250# EDR to 42,500# EDR at normal SBI steam ratings with certified output ratings from 6375# EDR to 63,750# EDR.

The Boiler-Burner Unit is detailed in a 14-page six-color brochure. In addition to descriptive details, the brochure includes an output rating chart; a cutaway drawing indicating all basic components; charts showing ratings, performance data, and dimensions; and a discussion of the various elements in the burner system.

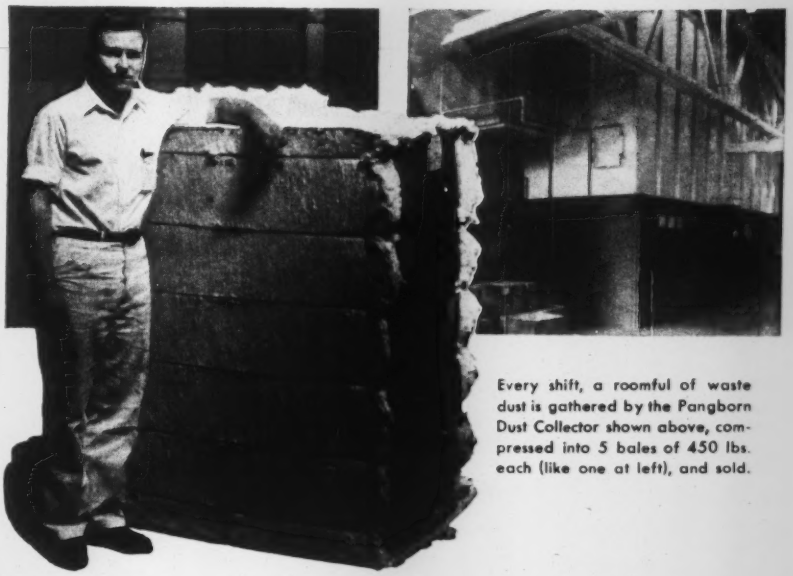
Copies of Bulletin B-3133 may be obtained from Titusville Iron Works Co., division of Struthers Wells Corp., Titusville, Pa., or Iron Fireman Mfg. Co., Cleveland 11, Ohio.

Larger Convertible Pump-Motor

The Berry Div. of Oliver Iron & Steel Corp. has announced the availability of its larger-horsepower 32-10 Series Rotodraulic hydraulic pumps, fluid motors, and transmissions.

The units utilize a rotating-piston design and may be used as either pumps or fluid motors interchangeably. As pumps the displacements are 60, 120, and 180 gpm at 1000 psi for continuous and 1500 psi for intermittent operation. Build-in gears allow direct connection at 1200 rpm, 760 rpm, or 472 rpm. Overhung belt or chain drives are permitted. When used as fluid motors, ratings up to 300 hp and 19,000 lb-in. of torque are obtainable at 1100 rpm.

This larger series of units will be applicable on earthmoving equipment, cranes, marine vessels, mining machines, sawmills, steel mills, drilling rigs, and similar equipment, according to the manufacturer. Further information is available from the Berry Div., Oliver Iron & Steel Corp., Henry W. Oliver Bldg., Pittsburgh 22, Pa.



Every shift, a roomful of waste dust is gathered by the Pangborn Dust Collector shown above, compressed into 5 bales of 450 lbs. each (like one at left), and sold.

Pangborn Dust Control traps over 2000 lbs. of dust a day

at Personal Products Corp.

Processing tissue and cotton items at Personal Products Corp., Chicago, Ill., frees great quantities of fibrous dust. To control this dust, a Pangborn Dust Control system at Personal Products filters 35,000 cu. ft. of air a minute.

Every shift, Pangborn equipment collects over 2000 pounds of dust which Personal Products bales and sells to paper mills and similar industries. During the winter, the already-warmed, cleaned air is reused, cutting fuel costs and eliminating need for additional heating equipment. And the dust-free atmosphere maintains working conditions at a high level.

Robert MontBlanc, Salvage Foreman at Personal Products, says: "The Pangborn Dust Collector is doing a good job. It improves working conditions, makes plant housekeeping less costly, saves money on heating costs, and gathers salable salvage material. The last factor alone makes Pangborn very much worth-while."

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

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with CHACE BIMETAL CONTROL

FOR ALMOST 30 YEARS, Birtman Electric Company has manufactured irons known for their reliability. This Birtman Iron carries a five-year warranty, a good indication of its quality. Of course, the actuating element is Chace Thermostatic Bimetal, a vital part in the fabric heat selector mechanism, one of the outstanding features of this Birtman product. Other interesting features are the finger tip dial regulator with positive shut-off and the light in the handle indicating when the iron is on.

The mechanism is interesting. An ingenious gear train, housed in the forward part of the handle, raises and lowers the double contact arm assembly "A," when the dial is turned. The thermostatic bimetal element "B" is fastened to the sole immediately below. When the sole heats up, the bimetal element bends upward and the insulated post presses against the contact arm, opening the contacts. Thus the circuit is broken, the sole cools slightly and the bimetal returns; once again the circuit is re-established and the heating cycle begins. Turning the dial clockwise raises the contact arm, lengthening the time the bimetal takes to break the contacts, hence the iron operates in a higher temperature range, as for linen. The opposite direction permits opening the circuit sooner and the iron heat is suitable for rayon or silk. With dial turned to "off," the contacts are held open indefinitely, a nice safety feature.

Chace fabricates this element ready for assembly by Birtman. We also furnish our 29 types of thermostatic bimetal in random length coils, strip and assemblies, to precision specifications. For real economy and efficiency, consult with our Application Engineers before proceeding with your next design. In the meantime, send for 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," with condensed engineering data.

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Thermostatic Bimetal
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IT BENDS WITH THE HEAT

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Scoop Attachment for Hydraulic-Powered Fork Trucks

A scoop attachment, designed for use on any of its hydraulic-powered fork trucks, has been developed by the Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

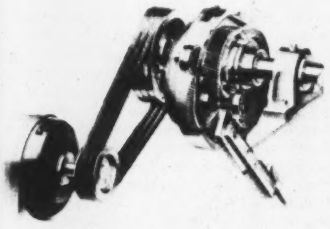
The attachment is specifically designed for handling such bulk materials as fine coal, salt, sulfur, grain, etc., but is not intended for loads where the lumps are large. It receives its hydraulic power from the same system which operates the lift and tilt on the vehicle.

Dimensions: overall width, $37^{3}/_{8}$ in.; cubic content, 25 cu ft; capacity, 3200 lb, (maximum capacity of scoop determined by truck capacity). Features of the scoop are its anti-friction bearings supporting the trunnions of the scoop, a double-acting hydraulic cylinder which moves the unit from the loading to the carrying position, and a replaceable wear strip on the lip of the scoops. Further information about the scoop attachment may be had by writing the Elwell-Parker Electric Co.

Shaft-Mounted Speed Reducer

Under the name "Shaft-King," a new 13-to-1-ratio series of shaft-mounted speed-reduction units has been introduced by American Pulley Co., 4200 Wissahicken Ave., Philadelphia 29, Pa.

Adaptable to any shaft size up to $3^{15}/_{16}$ in., Shaft-King speed reducers require only standard shaft lengths (twice the shaft diameter plus clearance) to be mounted directly on the shaft of the driven machine, according American Pulley.



Two trains of flame-hardened helical gears reduce the driven shaft speed to obtain a 13-to-1 ratio. Gearing and bearings are continuously splash-lubricated by the high-speed gear and the counter-shaft pinion which operate in an oil reservoir in the lower third of the three-wall housing.

Another Shaft-King construction feature is the patented concentric-shaft design which places both the input and output shaft above the oil level. Additional features include a leakproof, anti-friction oil sealing system, interchangeable split-tapered bushings, and the use of both ball bearings and tapered roller bearings.

For protection against sudden overloads or jamming conditions, Shaft-King speed reducers can be equipped with the American torque-arm overload release. As a safety precaution on applications where reversing must be prevented, Shaft-King speed reducers may also be equipped with an internal backstop. Both the overload release and backstop features are optional.

Speed ranges are from 11 to 154 rpm, with driving-motor limits of from fractional to 42.8.

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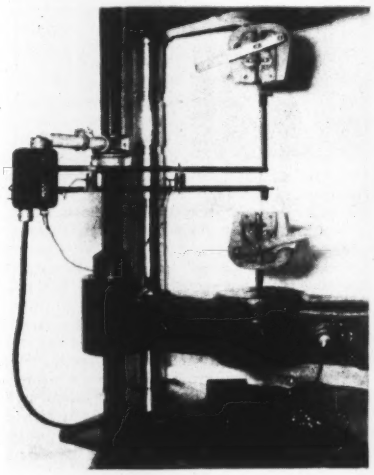
NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Microformer-Type Extensometer

A Microformer-type extensometer designed to produce stress-strain diagrams with high strain magnifications and low magnifications respectively below and above the elastic limit of materials has been announced by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa. The new Baldwin TS-M Dual Extensometer is used with a recorder of the Microformer type, employing these variable miniature transformers for transmission of strain variations.



Ten strain magnifications ranging from 5:1 to 200:1 are provided by means of Microformers at three positions on extensometer slide and horizontal arms, by the use of extension arms, and by the selection of three magnifications available in the Baldwin Microformer recorder.

Dual magnification is accomplished during any tensile test by switching manually from one to another of the Microformers on the extensometer when any selected value of strain or stress is reached. A selector switch connects to the recorder outlet receptacle.

With standard optional adapters this extensometer can be used on wires, flats, and round specimens. Wires may be of 0.02-in. to 0.25-in. diameter with gage lengths of 2 in. and 8 in., or 10 in. Round specimens may be of 0.25-in. to 2-in. diameter with 2-in. gage length. Flat specimens may be up to 1 in. thick and $1^1/_2$ in. wide with gage lengths of 2 in. and 8 in., or 10 in. Elongations as great as 2 in. are measurable.

The measuring unit assembly is supported by an adjustable arm which is clamped to one of the vertical columns of the testing machine. The slide frame is designed to assure straight linear movement of the Microformer and core near the pivots. The extensometer may be used with or without the arm extension on which one of the three Microformers is mounted.

Gas-Pressure Gages

The Draeger line of gas-pressure gages is being handled in the United States by Competition Chemicals, Box 141, Iowa Falls, Iowa.

Made in Germany, the gages accommodate ranges of 0–5000 psi, with diameters of cases $1^1/_4$, $1^1/_2$, 2, $2^1/_2$, $3^1/_8$, 4, and 6 in. The gages have a Bourdon-tube movement. Standard connection threads are $^1/_8$, $^1/_4$, $^3/_8$, or $^1/_2$ in.

Special gages and several styles of gages are also made by the Draeger firm. Further information is available from Competition Chemicals.

Internal Heat-Exchanger

An exclusive feature, available in all Farris nozzle and semi-nozzle safety relief valves, is an internal heat-exchanger. This unit can be incorporated in the valve body without creating interference with the rest of the valve mechanism.

The internal heat-exchanger eliminates the necessity of steam tracing or steam jacketing a valve where highly viscous lading is encountered, Farris declares. It consists of a steel coil inserted into the valve body and led out to connect with a steam line. The coil ends are accessible for return-pipe installation or one-pipe installation with a vent valve. A steam trap drains the coils and the construction is suitable for back pressure.

Further information can be obtained from Farris Engineering Corp., 612 Commercial Ave., Palisades Park, N. J.

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SERVING INDUSTRY FOR 41 YEARS

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Detailed information gladly sent you upon request.

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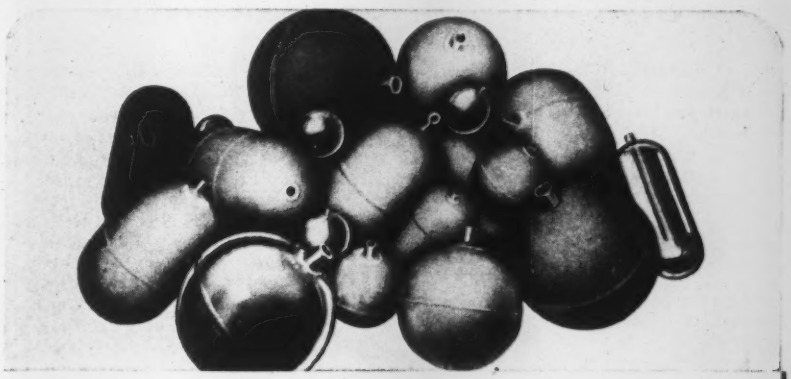

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FLOAT BULLETIN 753

Complete Data on Welded Floats; Diagrams, Tables, Formulae for Calculating Buoyancies

The booklet is a standard reference for specifiers of welded floats. Nicholson furnishes any type for external or internal pressures; in stainless steel, Monel, chromium, cadmium or copper-plated steel. Sizes, 2" to 14" diam., press. to 4800 lbs.; standard or special connections. Quick delivery on many sizes and shapes. Nicholson floats are standard with hundreds of manufacturers.

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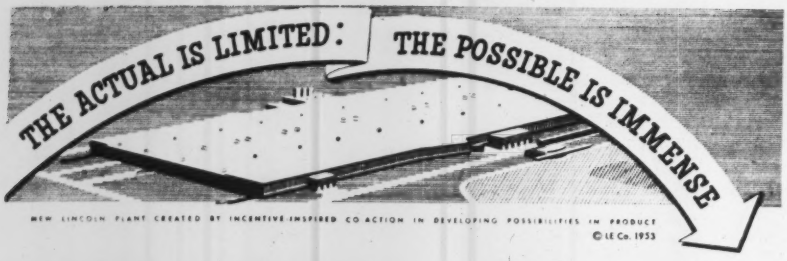
THE ACTUAL IS LIMITED:
THE POSSIBLE IS IMMENSE
NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT
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AUTOMATIC LINCOLNWELD SPEEDS PRODUCTION

INCREASES FRAME STRENGTH, RIGIDITY

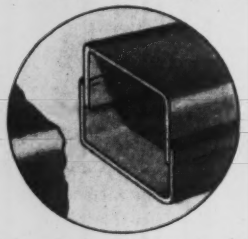

Fig. 1. Two U-shaped stampings *of hot rolled carbon steel are automatically welded into frame side rails. Speed . . . 36 seconds. Only two operators required per machine for complete operation.*

Fig. 2. Completed frame assemblies *are twisted and vibrated severely to test strength of machine welds. No fracture of welds has ever occurred.*

HERE'S HOW

OUTPUT INCREASED 5 TIMES WITH AUTOMATIC LINCOLNWELD

AUTOMATIC welding of automobile frame side rails has increased output by 5 times. Four automatic Lincoln machines now weld 80 rails per hour at the Frame Division, Murray Corporation of America, Ecorse, Michigan.

Each machine has 6 Lincoln "hidden-arc" heads which weld at speeds of 120 inches per minute. Entire operating cycle per rail is only 36 seconds. All operations, including welding, clamping, feeding of wire and flux, tracing and slag removal, are fully automatic. After welding, the heads retract and the assembly is kicked out by ejector pins.

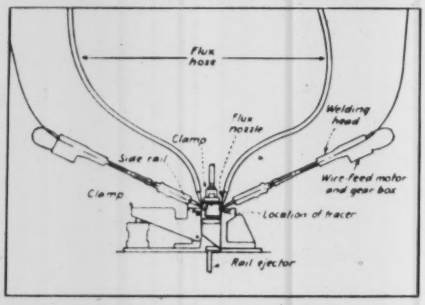

Fig. 3. Automatic "hidden-arc" welding *heads move into position after side rail is clamped. Heads guided along seams by tracer and contour compensating device for 1/32" alignment of wire and joint.*

Welding speed is increased 400% over previous manual welding. Controlled time cycle and uniform heat input keep frames within 1/8" end tolerance—less than possible with hand work. Cratering is eliminated. Entire operation uses only 25% of floor space previously required.

GET THE FACTS! *Latest data on procedures and speeds with Automatic Lincolnweld are available in Bulletin 439. Write on your letterhead to Dept. 480A.*

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 17, OHIO

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

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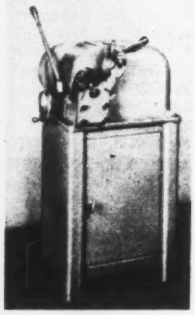
Tube Flarer

Parker Appliance Co., Cleveland 12, Ohio, has announced that it has designed and is now manufacturing a powered tube flarer. The new unit was conceived to put tube flaring on a high-volume production level.



Designated Model 232A, the new unit produces perfect, concentric, smooth-surfaced, 37-deg. tube flares for use with standard Triple-lok and AN tube fittings, according to the announcement. The flares meet the following standards: AN, JIC, SAE Hydraulic, and ASME. The machine will flare the full range of standard tube wall thicknesses and all tube sizes from 1/8-in. through 2-in. outside diameter.

Annealed seamless copper, aluminum, steel, and stainless steel tubing can be handled.

In addition to flaring, the unit, by virtue of interchangeable heads and accessory attachments, can be used for square-burring of tubes. For square-burring, the unit will handle tube sizes ranging from 1/8 through 2 in. in outside diameter.

High-Temperature Thermal Switch

Control Products Inc. has announced full production on the new CPI two-wire-type super-high-temperature thermal switch.

Designated type ASA-21-2 by the manufacturer, the new switch is designed for extremely high-temperature applications in jet engines, gas turbines, after-burner controls, or wherever temperature warning is required to 2000 F. Type ASA-21-2 is a non-grounded switch and has maintained set calibration for 100 hr at 1500 F with a variation of only 10 F. Contacts are welded on flexing-type arms. Switch is constructed of stainless steel throughout and weighs approximately 6 oz. It is available normally open or normally closed.

The new thermal switch complements the line of thermal devices and waterproof switches manufactured by Control Products. Specifications and an illustrated catalog will be sent by the manufacturer, Control Products Inc., Sussex St., Harrison, N.J.

Carbide-Tipped Radial-Saw Blades

A new line of low-cost carbide-tipped saw blades designed especially for use with radial saws will reduce machine downtime and eliminate many common blade problems in a number of industrial cutting operations, according to the manufacturer. Introduced by the Delta Power Tool Div. of the Rockwell Mfg. Co., these carbide-tipped blades are said to be the first to be mass-produced.

Two major advantages are attributed to the new blades: longer life and ease n cutting hard or abrasive materials.

The blades are offered in 10-, 12-, and 14-in. diameters to fit standard arbors and in 24-, 30-, and 36-tooth types respectively. Further information is available from the Delta Power Tool Div., Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Sealed Bearings for Wheels

Development of a sealed bearing for industrial casters and wheels has been announced by the Bassick Co., Bridgeport 2, Conn. Described as a labyrinth-type seal, the Bassick development eliminates the necessity for specially prepared surfaces to insure proper sealing, according to the manufacturer. The bearing can be re-greased by standard grease-gun technique through regular Alemite pressure fittings.

According to Bassick, the new sealed bearing is now available on a growing number of Bassick wheels, at an addition of $0.50 each to the list price.

Rotary-Feeder Air Lock

A new rotary-feeder air lock for handling bulk material under high pressure or vacuum has been announced by Beaumont Birch Co., 15th and Race St., Philadelphia, Pa. Applicable to chemical and food processing, it is available in cast iron, stainless steel, or Monel.

Beaumont states that high-pressure application is possible because of the method of sealing ends of rotor. This is accomplished by means of a seal, which may be spring loaded, of rawhide, neoprene, asbestos, or teflon, either run dry or lubricated as required. Further assurance against leakage is obtained by the injection of an inert gas under pressure between ends of rotor and casing.

Shaft is also sealed against leakage and bearings may be either ball bearing or high temperature bronze. Rotor is available with six pockets or more and vanes are hard-surfaced, ground, and polished.

Beaumont claims that in addition to its high pressure applications, this rotary feeder is unique in that the casing ends are fastened with only four bolts, an advantage in applications such as the food industry where frequent dismantling for cleaning after each batch is a requirement.

Rack-Mounted Oscillograph

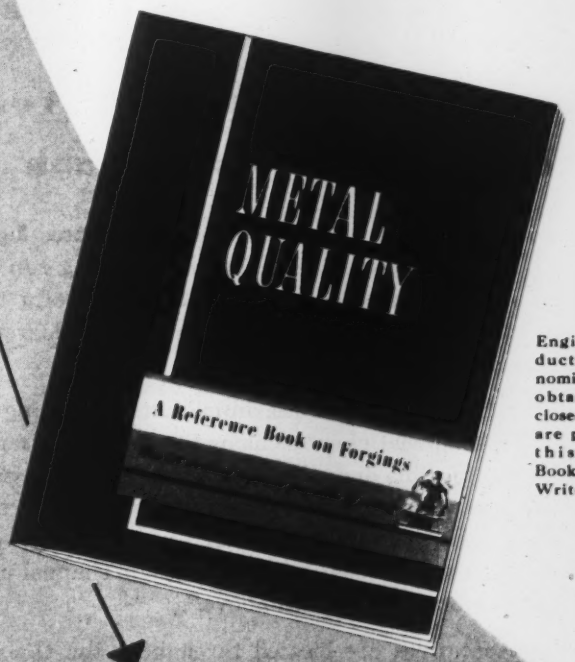
An electrical equivalent of the Du Mont Type 304-A Cathode-Ray Oscillograph is now available as a rack-mounted unit. The rack-mounted version is designated as the Type 304-AR, according to the Instrument Div., Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

The Type 304-AR features the same built-in voltage calibration as the Type 304-A. The illuminated screen is specially calibrated for reading any portion of the signal directly in volts. The screen is calibrated by a push-button control on the operating panel which applies a standardizing potential to the screen.

The rack-mounted oscillograph requires 8¾ in. vertically in a standard relay-rack. Front panel is designed for accommodation of supporting fastenings. Special panel finishes are available to match manufacturer's requirements.

The Type 304-AR incorporates a flat-faced, tight-tolerance cathode-ray tube, Type 5ADP-, to increase accuracy of measurement. Voltage reading range on a four-inch scale is from 0.10 v to 1000 v, full scale. Frequency response is flat at direct current and extends to 300 kc, 50 per cent down. All electrical characteristics of the instrument are identical to those of the Du Mont Type 304-A Cathode-Ray Oscillograph.

Forgings — closed die forgings — with their unmatched economic and mechanical advantages offer quick and complete solutions for Problem Parts problems confronting any member of a production team. Consult a forging engineer about the closed die forging process for producing parts with the correct combination of mechanical properties required for your product.



Engineering, production and economic advantages obtainable with closed die forgings are presented in this Reference Book on Forgings. Write for a copy.

DROP FORGING ASSOCIATION
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Please send 60-page booklet entitled "Metal Quality — How Hot Working Improves Properties of Metal," 1949 Edition.

Name _____
Position _____
Company _____
Address _____

Photo courtesy Sperry Gyroscope Company

BOMBING RUN IN THE LABORATORY

charted by Brush Oscillograph

On the analog computer, this engineer has duplicated flight conditions for a new jet plane making a bombing run on automatic pilot. Then he checks the performance of the system as charted by the six-channel Brush Oscillograph. Mission accomplished!

In many such exacting studies, immediate recording of electrical or mechanical phenomena by Brush Oscillographs saves engineering time and simplifies tests. These precision instruments give you answers in writing—of stress, strain, torque, vibration, pressure and other variables. They are available to suit your needs... from the single channel unit up to the six-channel size shown above.

Brush representatives are located throughout the U.S. In Canada: A. C. Wickman, Ltd., Toronto. For bulletin, write Brush Electronics Company, Dept. P-9, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY

INDUSTRIAL AND RESEARCH INSTRUMENTS
PIEZO-ELECTRIC MATERIALS • ACOUSTIC DEVICES
MAGNETIC RECORDING EQUIPMENT
ULTRASONIC EQUIPMENT

BRUSH ELECTRONICS

formerly
The Brush Development Co.
Brush Electronics Company
is an operating unit of
Clevite Corporation

Hand-Operated Metal-Roller

Addition of six new models of a hand operated roller, said to increase the material capacity and forming width over previous models, has been announced by O'Neil-Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn.

These models, designated Di-Acro Rollers, have a material capacity ranging from 16 to 24 gage sheet steel, forming-width range of 12 to 42 in., and radius capacity from 2 in. to infinity. The company states that these rollers incorporate a cam-idler feature into their design which makes it possible to form circles of any diameter in two passes through the rolls.

Circles of the same diameter as the forming rolls or slightly larger can be formed in one pass through the roller by making a slight adjustment, according to O'Neil-Irwin. Bends can also be located in any position along a sheet of material being formed in the roller because the material can be fed through the rolls without bending until the cam lever is engaged, the company pointed out.

Round, flat and square stock as well as many other ductile materials can be formed with the machine. Special rolls for special bending jobs can be supplied. Sample material with specifications may be submitted for test forming or sample duplication, the company says. Cost of the Di-Acro Roller ranges rrom $110.00 to $355.00. Delivery can be made on most models in approximately four weeks. Complete information furnished on request.

Pressure Transducer

A pressure instrument claimed to operate under conditions of extreme vibration and acceleration has been announced by G. M. Giannini & Co., Inc., 117 E. Colorado St., Pasadena, Cal., and East Orange, N. J. The Model 45176 Pressure Transducer with potentiometer output has been designed so as to be adaptable to many uses in industrial, missile, or aircraft applications; as an altimeter; and for air-speed pressure or ram pressure measurement. Up to 50 v output can be obtained where an electrical signal proportional to pressure is required. A frictionless spring-flexure pivot-movement design is used, which requires no gears or bearings to obtain movement amplification. The operating assembly is statically and dynamically balanced to reduce vibration effects.

The output of the standard instrument is linear with applied pressure, but outputs can also be supplied linear with altitude, air speed, or to natural or empirical functions. Dual outputs can be provided, and each output in a dual system can be made to meet different specific functions.

The Model 45176 pressure instrument is available in ranges from 0–10 to 0–30 psi in 5-psi increments, in special pressure ranges, and can be had with various resistances and with cases that will withstand pressures of 150 psi. A low-loss filter is furnished in the input pressure port, and models are available with temperature compensation. The unit will operate when subjected to environmental vibrations of 5G in the frequency range from 10–500 cps and can be made to withstand shocks of 40G without structural damage, according to the company. Weight is less than 14 oz.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Motor-Driven Tramrail Trolley

A motor-driven trolley for tramrail service which can be furnished with any one of 18 travel speeds by changing two or four gears has been announced by The Forker Corp. The units may be constructed to short-wheel base at 25 in. in four-wheel design and 16 in.-16 in.-16 in. n eight-wheel design. Longer wheel bases are available.

The electric-powered trolley is designed for use with Ohio Tramrail Shielded Safety-Type Electrification, which carries the current conductor bars in a metal housing directly under the track. The current collector shoe is located in a protected position inside the trolley yoke and resting on the load bar. A double-reduction straight spur gear drive is used to power the drive wheels. A choice of 18 gear reductions is obtained by altering ratios between motor pinion and B gear, and altering the C pinion and D drive gears in the second reduction.

The range of travel speeds available through selection from the 18 gear reductions possible is further expanded by choice of electric motor speeds. High-starting-torque electric motors with 1800, 1200, and 900 rpm permits choice of travel speeds of Ohio Tramrail Motor Driven Trolleys ranging from 56 to 600 fpm. Gears are made of C-1035 steel with cut teeth. The pinion gears are heat-treated. The cut gear teeth are made with $^{6}/_{7}$ and $^{6}/_{8}$ diametral pitch and 20-deg stub tooth.

The heat-treated steel drive wheels drive on top of the track. They are of $3^{11}/_{16}$-in. diameter. The wheels are crowned and are not flanged. Four heat-treated guide rollers, mounted on the trolley frame, position its direction of travel.

The trolleys may be obtained to operate at an approximate single, or selective variable, speed of 56, 75, 100, 125, 150, 200, 250, 300, 450, or 600 fpm, and other intermediate speeds, with a full-rated load from creeping to maximum speed in both directions. Further information about the motor-driven trolley may be obtained by writing to The Forker Corp., 2015 Random Rd., Cleveland 6, Ohio.

DEFINITIONS OF OCCUPATIONAL SPECIALTIES IN ENGINEERING

A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

Prepared by the ASME with the assistance of representatives of pertinent national engineering societies.

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Maximum Electronic Performance in any WEATHER with

LORD TEMPROOF MOUNTINGS ON COLLINS 618S-1 TRANSCEIVER

SENSITIVE electronic equipment for airline transmitting and receiving must give continuously accurate results. For instance, note this "inside" view of the Collins Transceiver, mounted on Lord Temproof Mountings which isolate it from vibration and shock. Lord Temproof Mountings function efficiently throughout operational ranges of temperature from —80° to +250°F. The Collins Transceiver with automatically tuned elements for maximum flexibility and high power output delivers maximum performance in any weather, completely protected from vibration, shock and excessive equipment motion at resonant frequencies by Lord Temproof Mountings.

May we give you further details on this Lord application or help you solve your specific mounting requirement?

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LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL**

SAE National Aeronautic Meeting, Hotel Statler—Booth No. 21
Los Angeles, California, Sept. 29–Oct. 3, 1953

Tips on TESTING . . .

. . . ELECTRICAL INSULATION RESISTANCE

Reconditioning Wet Apparatus

The bad effects of excessive moisture in insulating material, particularly when localized, are numerous. The effect most likely to result in failure in the early stages of exposure is that of low resistance paths which may develop either through or over the surface of the insulation. The likelihood of failure from this cause is increased by the presence of dirt and other foreign matter, and may occur in either organic or inorganic insulating material.

If moisture has been deposited on clean insulation only superficially, then the heat resulting from the normal operating temperature of the equipment may remove it before failure occurs. However, the normal operating heat of at least some parts of the equipment is sometimes insufficient to drive out moisture that has penetrated through surface defects.

If moisture is allowed to remain in insulation, it usually—in time—causes corrosion of metal conducting parts, aggravated by the presence of chemicals and electric potential, thus increasing the danger of failure.

In addition to apparatus which may be exposed to moist atmosphere, or wet with fresh water, there may be occasions when it becomes necessary to rehabilitate equipment that has been subjected to salt water. In such case, clean fresh water must be used to remove all traces of salt before drying of the apparatus is attempted. Any evidence of oil or grease on the insulation should also be removed by using a volatile solvent such as carbon tetrachloride.

Then the apparatus must be dried out before electrical potential is supplied. Numerous methods and various temperatures for drying out electrical equipment are used, including forced hot air, ovens, circulating electric current through the conductors, or combinations of these methods. Local conditions and facilities, manufacturer's recommendations, and the type of equipment involved, dictate the method used.

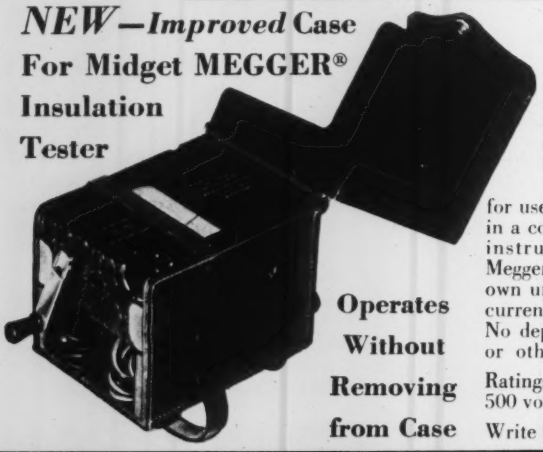
Test Procedure

If possible, secure records of previous insulation resistance tests on the apparatus.

Make short-time tests and time-resistance tests for comparison to help decide whether drying is necessary. If present readings are at all comparable with previous tests made at or corrected to the same temperature, a drying-out run *may* not be necessary.

NOTE: *The above material is taken from our Instruction Manual—for the use of Megger Insulation Testers. Within its 96 pages, such subjects as "Temperature Correction", "Interpretation" and many others are discussed in a clear and interesting manner with very ample illustrations, charts and tables. We'll be glad to send you a copy of this manual without obligation. Just write on your company letterhead for* ***Manual 21-J-M.***

NEW—Improved Case For Midget MEGGER® Insulation Tester



Operates Without Removing from Case

The ever-popular Midget Megger Insulation Tester is packed in a leather case of new design. As with a fine camera case you simply flip back the lid of the case and the instrument is ready for use. The leads are stored in a compartment under the instrument. The Midget Megger Test Set contains its own unfailing source of test current in a hand generator. No dependence on batteries or other power supply.

Ratings up to 50 megohms, 500 volts d-c are available.

Write for **BULLETIN 21-85-M**

JAMES G. BIDDLE CO.

ELECTRICAL TESTING INSTRUMENTS
●
SPEED MEASURING INSTRUMENTS
●
LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET, PHILADELPHIA 7, PA.

James G. Biddle Co. B-934
1316 Arch St., Phila. 7, Pa.

Gentlemen:

Please send me ☐ Manual 21-J-M
☐ Bulletin 21-85-M

NAME

JOB FUNCTION

COMPANY

ADDRESS

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Magnet for Gas Truck

Especially adapted for the handling of castings, cast iron or steel borings, and steel turnings is a 6,000-lb capacity Yale Gas truck with a lifting magnet supported on a gooseneck boom.

Manufactured by the Yale Materials Handling Div., of the Yale & Towne Mfg. Co., Philadelphia, Pa., the truck mounts a 36-v model Z-36 Ready-Power unit which supplies the current to energize the magnet. Fingertip controls are used for raising the load and energizing the magnet.

The lifting magnet can be hung at any one of four different positions on the boom and the hook capacity varies from 4,700 lb at 36-in. outreach to 3,000 lb at 72-in. outreach.

High-Magnification Extensometer

A new high-magnification extensometer for gage lengths of $^4/_{10}$ in. or $^1/_2$ in. is now available from Tinius Olsen Testing Machine Co., Willow Grove, Pa., for $^1/_{16}$-in. to $^3/_8$-in. diameter specimens. The $^4/_{10}$ gage length model is recommended for standard 0.113-in.-diameter specimens.

The Type S-9 Electric Extensometer is used with the Olsen Model 51 Electronic Recorder for detecting strain under both elastic and plastic tension tests. The instrument is provided with magnifications of 50, 100, and 200, which are available by the turn of a switch. Overall dimensions of the S-9 are approximately $^3/_4 \times ^7/_8 \times 1$ in.

Other S-type high-magnification Extensometers are available for gage lengths of 1 in., 1.4 in., 2 in., 8 in., and 10 in. For further information and specifications, write to Tinius Olsen Testing Machine Co. 1164 Easton Rd., Willow Grove, Pa.

Crossbar Switch

A crossbar switch adaptable to a wide range of uses in multiple switching of audio and video circuits, in computer systems, and many other applications, has been markete 1 by James Cunningham, Son & Co., of Rochester, N. Y.

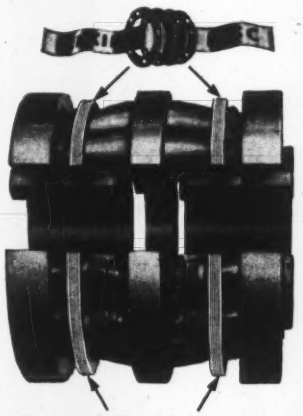
Advantages claimed for the switch are ability to handle high frequencies, extremely low crosstalk level, rapid operation, and compactness. It is available with 4 or 10 link levels, and either 10 or 25 line levels. Each circuit may have up to 3 conductors. Flexibility in the design permits modification to meet many special requirements.

Excellent transmission said to be achieved at frequencies as high as 70 megacycles. Bridging capacitance between adjacent conductors is 15 mfd. The crosstalk level between the two circuits with common ground, and adjacent in both line and link levels, is down more than 65 db at 10 megacycles.

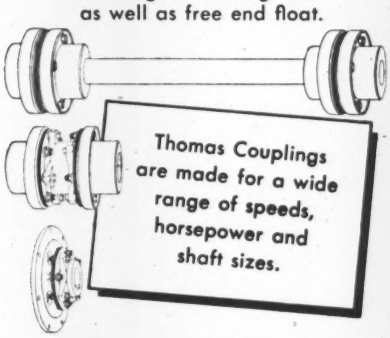
Each of the electromagnets requires 200 amp turns, equivalent to 2.5 w. The coils will dissipate 3 w continuously. Coils are available for operation at 12, 24, or 48 v. Control of the switch may be either by manually operated keys, by automatic control circuits, or by dialed impulses. Circuits are available for channeling circuit paths through the switch and preventing simultaneous seizure. Additional information about the Cunningham Crossbar Switch can be obtained from James Cunningham, Son & Co., 13 Canal St., Rochester 8, N. Y.

Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs

DISTINCTIVE ADVANTAGES	
FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT

NO MAINTENANCE PROBLEMS

ALL PARTS ARE SOLIDLY BOLTED TOGETHER

Write for our new Engineering Catalog No. 51

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

High-Speed Counter

The Streeter-Amet Co., has announced an Ametron Miniature Numerical Indicator, a high-speed instrument designed for high readability.

The high-speed numerical counter is geared to a servo motor and can be installed long distances from the measuring point without lag difficulties. It can be used to measure velocity, temperature, light, weight, length, and many other variable quantities. It can also be used in conjunction with recording units in applications where continuous readings must be available to facilitate batching and processing operations, etc. An illustrated circular will be sent on request by Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

Standard Low-Pressure Storage Tanks

The manufacture of standard tanks for storage of materials at atmospheric or low pressures has been announced by the Jobbing Div. of Aluminum Co. of America. Previously all tanks were tailor-made to customer specifications with materials ordered as needed.

Standard tanks can be had in capacities ranging from 5800 to 16,400 gal and are of both horizontal and vertical types. All tanks are 10 ft in diameter and are made from 1/4-in. welded 3-S aluminum alloy.

The horizontal tanks come in capacities of 6400, 11,400 and 16,400 gal. The vertical tanks designed to be supported on a flat base come in capacities of 5800, 10,800, and 15,800 gal. The vertical tanks designed to be supported on six legs come in capacities of 6400, 11,400, and 16,400 gal.

All these standard tanks can be equipped with a 20-in. inside diameter manhole, either of the fixed or swing type. The hinged cover can take no internal pressure and is not vapor proof. The other, or fixed type, can take some pressure.

Also, standard welded neck connections can be had with small added cost. These neck connections come either in the Van Stone connection—which has a movable steel flange and can easily be aligned with the opposing flange on adjacent piping—or the welded neck which has an integral flange.

While some gage pressure can be applied to the tanks, no rule-of-thumb can be given, according to the manufacturer. Such items as position of tank, horizontal or vertical, and weight of the contents must be known before gage pressures can be figured.

Valve Actuators

Designed as package units for installation directly on the valve in service, on valves at manufacturer's plant, or at distributor's warehouse, the new line of Ledeen Valve Actuators are for the automatic operation of gate, plug, diaphragm, butterfly, pulp-stock, and other flow-control valves. They are mounted directly on the valve without need of outside support. Operated by air, gas, oil, water, or steam, they feature power operation and direct or remote control.

The line is illustrated and technically described in Bulletin 3000, which includes actuator-selection instructions and tables. Copies of Bulletin 3000 may be had by writing Ledeen Mfg. Co., 1600 S. San Pedro St., Los Angeles 15, Cal.

Enco

Extra Power Quickly
...and easily...
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- Provide cross-flow of gases over tubes for maximum heat-transfer
- Tapered gas passes and curved surfaces streamline the gas flow and maintain gas velocity for efficient heat-extraction
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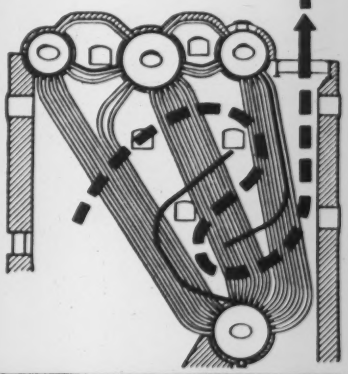
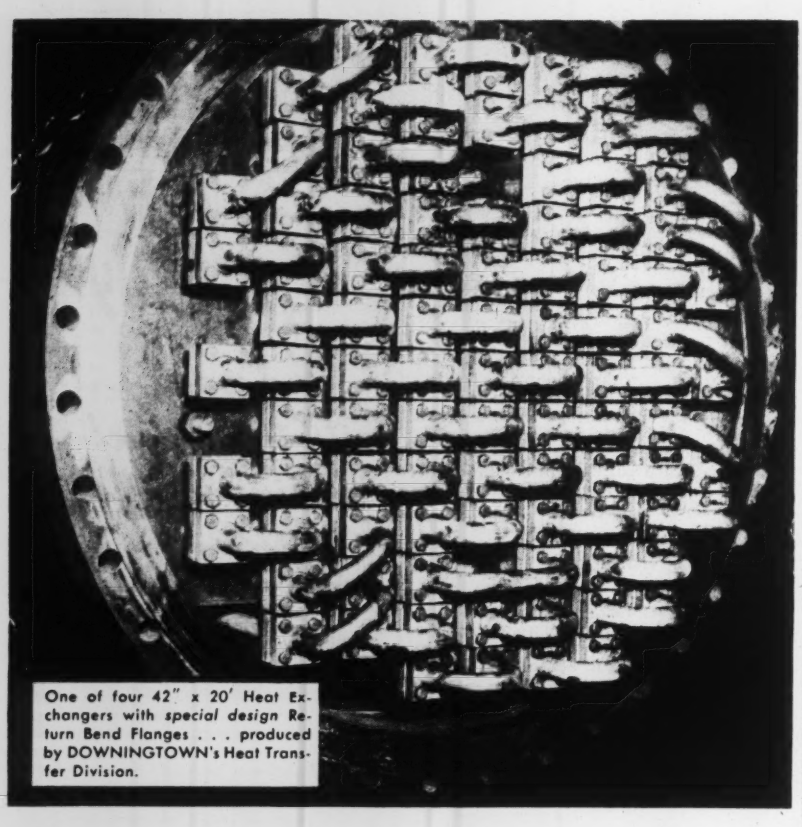
- Applicable to any design of water-tube boiler, fired by any fuel
- Each installation is designed on the basis of 25 years experience in this specialized branch of engineering
- Installed by skilled mechanics

Ask for bulletin BW 40 giving valuable data on modern baffle-wall constructions — free



THE ENGINEER CO.
Enco 75 West St. New York, N. Y.



One of four 42" x 20' Heat Exchangers with *special design* Return Bend Flanges . . . produced by DOWNINGTOWN's Heat Transfer Division.

the unusual is usual with us

. . . yes, let DOWNINGTOWN'S experience and research in the fabrication of various grades of Carbon Steel, Stainless Steels, Nickel-Clad, Stainless-Clad, Monel-Clad, Cupro-Nickel, Aluminum, etc., be of help to you. We are equipped with the most modern facilities to handle complete jobs, within our limitations, in the correct alloys and methods of fabrication required to assure maximum operating efficiency.

DOWNINGTOWN'S Heat Transfer Division is under the direction and supervision of men thoroughly trained and experienced in this field. Our Engineering Consultation is at your service to aid you in preparation of plans and specifications for definite jobs.

Useful literature gladly sent upon request. Remember: "your needs are our specialty!"

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DOWNINGTOWN IRON WORKS, INC.
DOWNINGTOWN-PENNA.
DIVISION OF PRESSED STEEL TANK COMPANY
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STEEL AND ALLOY PLATE FABRICATION AND HEAT EXCHANGERS

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Insulation Tester

The James G. Biddle Co. has introduced a new carrying case for its Midget Megger Insulation-Tester, which now can be operated without removing from the case. Flipping back the lid makes the instrument ready for use, just like a camera case. The leads store in a compartment under the instrument. The Midget Megger Electrical Insulation Tester contains its own source of test current in a built-in hand generator. Ratings up to 50 megohms, 500 v d-c, are available.

The cases are available separately. For information on these instruments, Bulletin 21-85-50 should be requested from James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.

Portable Power Saw

The Key-Hak Portable Power Saw attachment fits any heavy-duty 1/4-in. electric or air drill or motor-driven flexible shaft. Drills with chuck speeds of 2000 to 3000 rpm are the most desirable power units, according to the company. The in-line mechanism of the tool is said to afford the operator complete control when cutting in any direction. Three ball bearings are used in the drive and crank mechanism.

Following assembly, the mechanism is sealed in a special lubricant which assures protection to all moving parts for approximately 500 hr of actual running, the manufacturer claims. Each tool is run tested at 2500 strokes per min before final inspection and packing. The Key-Hak is designed to cut directly, without the aid of a starting hole, into 20-gage or lighter sheet metal, as well as into wood of any thickness. Special saw blades are available for cutting stainless steel, Monel, Chromoloy, and chrome vanadium. Other saw blades designed for cutting bronze, copper, aluminum, zinc, and lead are also available from the manufacturer. Scroll cuts as well as straight cuts can be made in a variety of building materials, including wood, heavy Transite, Masonite, and Gypsum block.

The manufacturers, Producers & Distributors, Inc., 714 S. Sixth St., Allentown, Pa., have prepared a folder giving information on the selection of blades for various materials to be cut, sent on request.

BUSINESS NOTES

Builders Iron Foundry Changes Name

Builders Iron Foundry has changed its name to B-I-F Industries, Inc. The name Builders Iron Foundry was adopted in 1853, when the company was incorporated. Its business was making castings for the building trades; now the output of the foundry represents less than 10 per cent of the company's total business. More parts come from the sheet metal shop than from the foundry. It was felt misleading therefore to continue the use of the word "Foundry" in the company's name. Subsidiaries of the company are Builders-Providence, Inc., Omega Machine Co., and %Proportioneers, Inc.%

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Clark Opens Philadelphia Office

The opening of a new Philadelphia office has been announced by Clark Bros. Co., Division of Dresser Operations, Inc., Olean, N. Y., compressor, engine, and turbine manufacturers. The new office is located in the Fox Bldg. at 1612 Market St., Philadelphia 3, Pa.

Heading the new office will be Ralph C. McDonald, formerly with the New York office.

Chain Belt Acquires Shafer Bearing

Chain Belt Co., Milwaukee, Wis., has announced the purchase of Shafer Bearing Corp., Downers Grove, Ill. The new addition will operate as the Shafer Bearing Div. of Chain Belt Co.

The Shafer line of industrial roller bearings will supplement the Chain Belt line of sprocket chains for power transmission and conveying in a wide variety of basic industries, such as oil, lumber, cement, rock products, pulp and paper, construction and mining, and agricultural. It is a product line suitable for sale and servicing by the domestic and export sales organization of Chain Belt, as well as by the established sales outlets of Shafer.

No change is made in the management responsibility. R. P. Tennes, former president, becomes division manager; M. J. Tennes, Jr., factory manager; H. E. Tennes, sales manager; A. H. Williams, chief engineer; H. R. Lucas, controller; Gordon Terris, director of distributor sales.

Revere Forms General Aluminum Sales Dept.

To consolidate all its general sales activities at its executive offices at 230 Park Ave., New York, N. Y., Revere Copper & Brass Inc. has announced the formation of a new Aluminum General Sales Dept. to parallel the company's Copper and Brass General Sales Dept.

Stanley H. Wilson, formerly sales manager of Revere's Aluminum Div. in Baltimore, has been appointed aluminum sales manager of the new department. Harold C. Wilson, assistant sales manager of the Aluminum Div., has also been transferred to New York as assistant aluminum sales manager.

Edward S. Bunn, formerly metallurgical manager of the Aluminum Div., has been assigned to Revere's General Manufacturing Dept. in New York. He will continue to carry primary responsibility on aluminum products and will assume additional responsibilities on copper, brass, and other mill operations.

Koppers Moves Freyn Dept. Headquarters to Pittsburgh

Headquarters of the Freyn Dept., Engineering and Construction Div., Koppers Co., Inc., was moved from Chicago to Pittsburgh August 1, it has been announced by George M. Carvlin, vice president and general manager of the Koppers division.

Koppers purchased the Freyn Engineering Co. in 1949 and it now operates as a department of Koppers Engineering and Construction Div. Freyn designs and constructs blast furnaces, open-hearth furnaces, sintering plants, continuous-casting machines, and other equipment for the steel and allied industries.

to rotate sludge rakes at exacting speeds in Process Clarifiers

WINSMITH SPEED REDUCERS

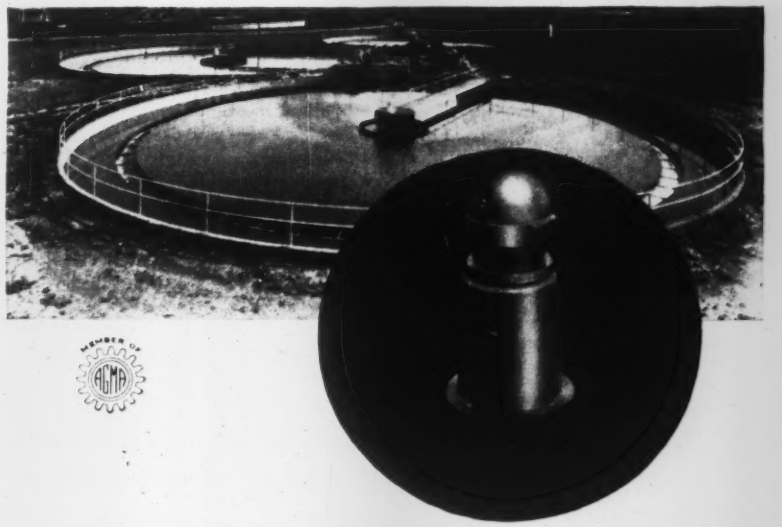
Under varying sludge loads, rake arms of this Process Clarifier sweep the 100 ft. diameter settling basin at speeds most ideal for sewage and water treatment. Lineal velocity of 10 ft. per minute must not be exceeded. Centered in the drive mechanism, powered by a 3/4 hp motor, a Winsmith Differential Gear Speed Reducer rotates the rakes at a consistent 1/30 rpm.

"The Winsmith unit was selected primarily for its high available reductions within a compact case . . . quiet operation, reliability," says Process Engineers, Inc. "Some of our installations . . . have been operating continuously over the last four years without shutdown for other than normal maintenance."

Rugged dependability and compactness have led numerous manufacturers to think of Winsmith *first* when they *first* think of speed reducers. It's the most complete, fully standardized line of worm, helical and differential units within the range of 1/100 to 85 hp.

Request Catalog 148 for details.

WINSMITH, INC.
333 JUNE ST.
Springville (Erie County), N. Y.



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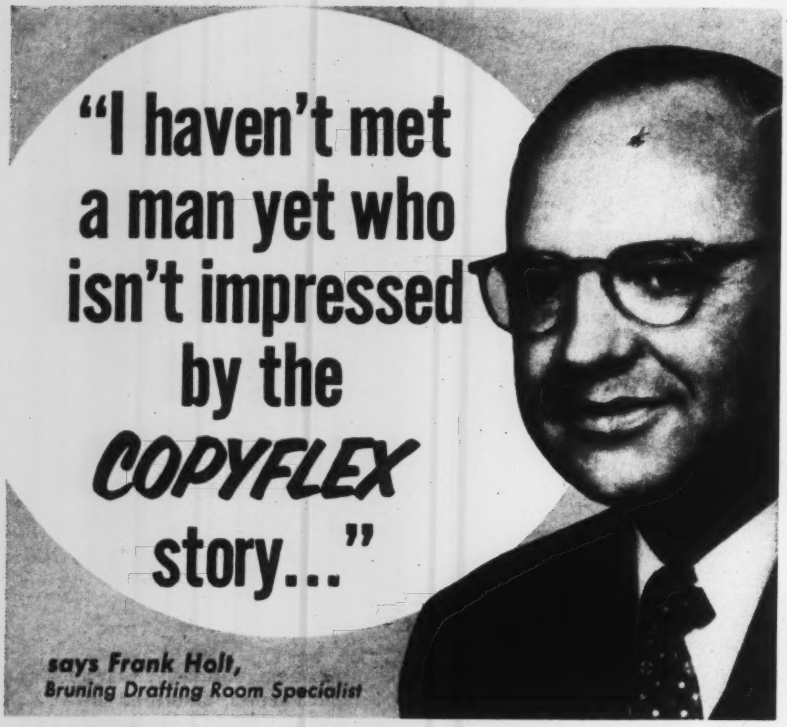

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"Elimination of expensive ventilation systems and plumbing makes a big hit, too."

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- **Complete Line of Drafting Supplies and Equipment**

B.3.6

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4700 Montrose Ave., Chicago 41, Ill.

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Everything for the Engineer and Draftsman

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Poole Names Wisconsin Distributor

Poole Foundry & Machine Co. has announced the appointment of Kramer Industrial Sales Co., 312 E. Wisconsin Ave., Room 301, Milwaukee 2, Wis., in the state of Wisconsin and the east portion of Iowa as their sales representative for the Poole all-metal gear lubricated flexible shaft couplings.

Factory Boilers To Pump Town Water

Pumping the water supply for the town of Helmetta, N. J., will be one of the duties of three boilers being built for the George W. Helme Co., manufacturers of tobacco, of Helmetta, by The Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.

The boilers are to be installed in the Helme Co. power house. In addition to providing the power for the pumps distributing water from brook and pond for general service supply, they will also furnish process steam for manufacturing operations and heating steam for the plant buildings.

The boilers are of the B&W Integral-Furnace FF type, self-contained units requiring a minimum of space in the already existing boiler room. Each will occupy an area of 324 sq ft, and is 14 ft, 7 in., high. They are water-tube boilers, which can be adapted to several types of firing. Initially, they will be oil-fired. Later, a stoker may be added, permitting the use of either method.

Each boiler will produce 18,000 lb of steam per hr operating at a pressure of 100 psi at a saturated temperature of 337 F.

Electrical Wiring With Aluminum

"Electrical Wiring With Alcoa Aluminum," the latest film in Aluminum Co. of America's series of "How-To-Do-It" motion pictures for users of aluminum, has recently been released.

The film was prepared originally for electricians working on the erection of Alcoa's Pittsburgh office building. Since it is designed for the man on the job, "Electrical Wiring With Alcoa Aluminum" deals almost entirely with techniques of handling and joining in installing aluminum conduit, cable, and wire.

The discussion of aluminum conduit covers cutting, reaming, threading, handling, and pulling cable. Compound use and preparation methods for joining wire and cable are explained. The four most frequently used types of connection for aluminum wire and cable—mechanical, loop joint, compression, and welded joints—are described, full details on making these are given, and suggestions as to the proper situations for their use are made.

Accompanying the film is a booklet, also titled "Electrical Wiring With Alcoa Aluminum." A brief, pocket-sized folder, it is both a checklist for points explained in the film and a source of information on characteristics of aluminum cable, wire, and conduit. The booklet is made available to all persons who view the film.

"Electrical Wiring With Alcoa Aluminum" is available through Alcoa Sales Offices or upon direct request to: Motion Picture Div., aluminum Co. of America, 818 Alcoa Bldg., Pittsburgh 19, Pa. An estimate of potential audience should accompany film showing requests.

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St. Louis Agency Named by Miniature Precision Bearings

Edwards Sales Agency of St. Louis is the newest distributor and exclusive sales representative for Miniature Precision Bearings of Keene, N. H., manufacturer of miniature bearings for instruments and precision mechanisms. William D. Edwards will be in charge of sales and engineering services to manufacturers in eastern and central Missouri, the southern half of Illinois, and the St. Louis industrial area.

Parker O-Ring Distributors

Two more companies have been signed as distributors of Parker O-rings, according to announcement by the Parker Appliance Co., Cleveland, Ohio. They are: The Palmer Supply Co., 222 Westlake Ave., N., Seattle 9, Wash., and Bearing Distributors, Inc., of 4515 Liberty Ave., Pittsburgh, Pa. D. N. Allensworth, Parker sales engineer in the Northwest, will work with the Seattle firm, and the Pittsburgh company will have the help of W. O. Murray, area sales engineer.

Worthington to Expand Plainfield Works

Worthington Corp. has revealed plans for an expansion and modernization program at its Plainfield Works.

Within the next nine months the corporation expects to spend over one million dollars to increase by one-third its production of construction equipment, positioning machines, and industrial mixers.

Plans are expected to bring about a 20 per cent increase in employment at the Plainfield Works when the new facilities are operating at full capacity. Most of the jobs will be filled in the Plainfield area.

Stainless Steel Motion Picture

A new motion picture, "Resistance Welding of Stainless Steel," has just been released by the Allegheny Ludlum Steel Corp. It discusses spot welding, seam welding, projection welding, and butt welding. It is a 16-mm sound and color film, using animation and drawings to clarify the regular picture material. Running time is 22 minutes.

Film is available on free loan from Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

Allis-Chalmers Division Opens Butte Office

R. D. Moody, manager of the Rocky Mountain region of Allis-Chalmers general machinery division, has announced the opening of an office in the Hirbour Bldg. in Butte, Mont.

Robert C. Nealey, a sales representative in the Spokane district office for the last several years, has been named resident representative at Butte.

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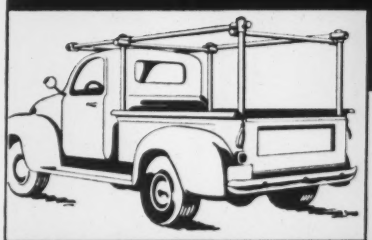
C P UNITED CEREBRAL PALSY

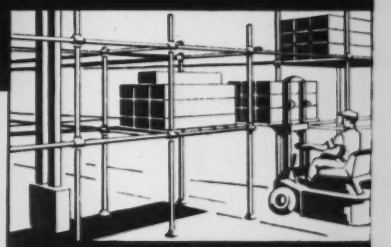
YOUR HELP IS THEIR HOPE!

GIVE TO YOUR LOCAL AFFILIATE

Structural Uses for ALCOA ALUMINUM PIPE

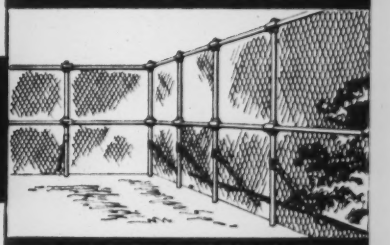


TRUCK RACKS



STORAGE RACKS

Quickly, easily assembled with Nu-Rail* Slip-On Fittings of Alcoa Aluminum. Other types of fittings also available.



FENCE FRAMES

*Manufactured by Hollaender Manufacturing Company 3841 Spring Grove Avenue, Cincinnati 23, Ohio

Advantages of Alcoa Aluminum Pipe:

1. LOW MAINTENANCE COST—Withstands most contaminated atmospheres without paint.
2. GOOD APPEARANCE—Bright, clean-looking.
3. STRONG—Has excellent mechanical properties.
4. LIGHT—Weighs 1/3 as much as steel, size for size.

With all these advantages, first cost is moderate. Schedule 10 costs little if any more per foot than Schedule 40 steel.

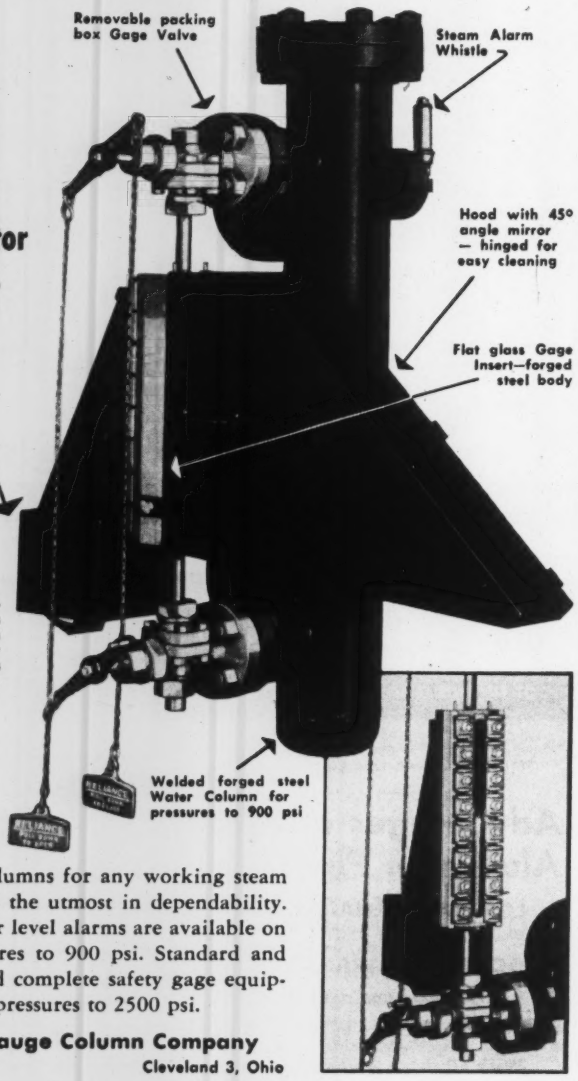
Most ALCOA distributors and jobbers stock Schedule 10 and 40 pipe and fittings in standard sizes. ALCOA can supply other sizes to your specifications. Consult your local ALCOA sales office or write: ALUMINUM COMPANY OF AMERICA 903-J Alcoa Building Pittsburgh 19, Pa.

Alcoa Aluminum

Your principal source

for modern Water Columns and Water Gage Equipment—

Reliance


Removable packing box Gage Valve
Steam Alarm Whistle
Hood with 45° angle mirror — hinged for easy cleaning
Flat glass Gage Insert—forged steel body
Welded forged steel Water Column for pressures to 900 psi

New . . .

Mercury Lamp Gage Illuminator for extra-clear and distant reading

Recommended for conditions where gages are 40 ft. or more from operating level, or for extra bright meniscus image. See cut at right.

Reliance Water Columns for any working steam pressure assure you the utmost in dependability. High and low water level alarms are available on columns for pressures to 900 psi. Standard and special columns and complete safety gage equipment are made for pressures to 2500 psi.

The Reliance Gauge Column Company
5902 Carnegie Avenue Cleveland 3, Ohio

The name that introduced safety water columns . . . . in 1884

Reliance®

BOILER SAFETY DEVICES

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Aeroquip Expands Facilities

Aeroquip Corp. has acquired the plant of Sterling Electric Motors, Inc., located at Van Wert, Ohio. The one-year old plant, which contains some usable equipment, is ready for immediate occupancy. Situated 100 miles south of Aeroquip's main plant in Jackson, Mich., the 45,000-sq-ft Van Wert plant, whose replacement value is about $500,000, is located on an 11-acre plot between the Pennsylvania Railroad's New York-Chicago main line and the Lincoln Highway, US 30. Aeroquip manufactures flexible hose lines with detachable, reusable fittings, and self-sealing couplings.

Combustion Engineering—Sulzer Bros. Agreement

Combustion Engineering, Inc., 200 Madison Ave., New York 16, N. Y. has announced that it has consummated a license and technical-assistance agreement with Sulzer Bros., Ltd., of Winterthur, Switzerland. Under this agreement, Combustion Engineering will manufacture and market Sulzer Monotube Steam-Generating Plants which have long been built by Sulzer Bros.

This agreement, Joseph V. Santry, chairman of Combustion Engineering, said, represents the culmination of several years' investigation of European development in the field of high steam pressures and is particularly significant at this time because of the interest in pressures above the so-called "critical pressure" of 3200 psig. At pressures above this point, Mr. Santry explained, the conversion of water to steam is instantaneous and skips the intermediate bubbling phase which characterizes the transition at pressures below critical.

Gas Meter Film

What is believed to be the world's first movie portraying the design, assembly, and operation of a diaphragm-type domestic gas meter has been issued by Rockwell Mfg. Co.

The half-hour 16-mm sound and color film, entitled "Operation 150," features an animation sequence showing exactly how a typical diaphragm meter, the lightweight Rockwell "150," accomplishes the measurement of gas.

Starting with a brief dramatized sequence on the role gas plays in the home of today and the reasons for metering, the film moves into a detailed account of the production of meter diaphragms and body castings. Selected sheepskins are shown being carefully tanned, checked for proper thickness with leather micrometers, die-cut into disks, shaped into diaphragm components on a blocking machine similar to those used in hat factories, and finally dried, oiled and "aged."

The film then shows assembly of the finished diaphragm with two leather components, the moving parts, sandwiched between two heavily tinned metal disks held together by rivets. Finished diaphragms are then inflated to fifty times their normal operating pressure and water-tested for leaks. Detailed pictures of the manufacture of valve plates, spuds, bearings and other metal parts of the meter follow.

Moving through a series of precision assembly operations, the meters are shown receiving vacuum tests. Following the animation sequence, final assembly and testing with bell provers and water tanks are shown in complete detail.

Hydrobuoyant Spheremotor

A chain of flexibly coupled, hollow rubber spheres loop over drive pulley and through air-filled "J" chamber. Underwater end of "J" chamber forms water seal as spheres go through aperture. Neglecting friction: Will this machine operate? If so, which way does it go?*

Design, development engineers...

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Most engineers do—of the off-beat variety like the one above as well as the more practical ones you're always running into at Honeywell.

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a systems, analysis or component design man, with experience in calibrators, recorders, amplifiers, computing receivers or circuits.

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Write J. A. Johnson, Engineering Placement Director, Dept. ME-9-189, Honeywell, Minneapolis 8, Minnesota. Learn in detail about the interesting opportunities at Honeywell. Ask for our book, "Emphasis on Research."

*Mathematical solution to above problem on request.

MINNEAPOLIS **Honeywell**

First in Controls

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The film also includes views of sealing, painting, and shipping of the tested meters. Made by a professional motion picture firm the film is available on request to Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa., or any Rockwell district sales office.

LATEST CATALOGS

Fastenings of High-Temperature Alloys

The H. M. Harper Co., Morton Grove, Ill., has issued an informative bulletin on high-temperature alloys such as Refractaloy, Discaloy, Inconel, Hastelloy alloys, A-286, etc., with a special section on titanium. The bulletin contains data on these super alloys, together with a section on the characteristics of high-temperature bolting. Tables give mechanical properties and chemical composition of various alloys and illustrate many types of fastenings produced from super alloys and titanium. A copy of Bulletin HTA will be mailed on request.

Pump Recirculation Control

Control systems for protecting high-capacity centrifugal boiler pumps during low load conditions is the subject of a bulletin just published by Republic Flow Meters Co., Chicago, Ill. By recirculating water through the pump during minimum flow conditions, the systems prevent the pump from overheating and binding at the joints, the manufacturer declares.

Information for determining when a recirculation system is needed is included in the 12-page bulletin. Both electrically and pneumatically operated control systems are discussed. Operation and arrangement of each system is fully described and illustrated. Valves and control equipment for each system are also pictured and specifications given.

Free copies of Bulletin No. S-53 are available from Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago 47, Ill.

Humidity Control

A new issue of The Humidity Engineer has been released by Surface Combustion Corp., Toledo, Ohio. Marine condensation, the resulting cargo damage, and the new marine-type air conditioning system installed on the Mariner Class ships to eliminate condensation are covered in the first article. This problem is similar to that encountered in waterworks filtration plants, breweries and sugar storage bins.

A second article covers the moisture problems encountered in the various steps of lithographic platemaking and explains the system of humidity control used by the Strobridge Lithographing Co. of Cincinnati. The Auto Specialties Mfg. Co. of Hartford, Mich., declares that their comfort air conditioning system has kept absenteeism at less than 1 per cent. How this resulted, and the added benefits of the system, are explained in a third article.

Copies of this issue are available from The Editor, Humidity Engineer, Surface Combustion Corp., Toledo, Ohio.

LUBRIPLATE No 630-AA IS PRACTICALLY A UNIVERSAL LUBRICANT

—says

THE SPOKANE PORTLAND CEMENT CO.

"With the introduction of LUBRIPLATE No. 630-AA, we were able to satisfy all our needs for solid type lubricants with only two LUBRIPLATE Products. LUBRIPLATE No. 630-AA might almost be considered a universal lubricant. Furthermore, it has effected marked savings in both lubricants and labor!"

For nearest LUBRIPLATE distributor, see Classified Telephone Directory. Send for free 56-page "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

Piping Problems?
For Fast Economical Installation and Longer Service Life
Specify RIC-WIL Prefabricated Insulated Piping Systems

Fast Economical Installation — Ric-wiL systems are prefabricated under ideal factory conditions leaving a minimum of work to be done in the field. Ric-wiL engineering service provides complete technical data and detailed working drawings — assuring rapid and accurate installation.

Longer Service Life — Ric-wiL systems are factory prefabricated on precision machines — all operations are carefully controlled eliminating chances for faulty workmanship to cause service failure.

Whether your problem involves underground or overhead piping — extreme temperatures or corrosive products — if proven insulated piping systems are required . . . it will pay you to call in your Ric-wiL representative as early as possible in your planning.

Ric-wiL PREFABRICATED INSULATED PIPING — UNDERGROUND OR OVERHEAD

THE RIC-WIL COMPANY • BARBERTON, OHIO

• "Unit Pilot Valve" easily removable—and renewable.

• Stainless Steel parts for lower maintenance, longer wear.

• Sizes from ½" to 6"—Screwed or flanged.

• Initial pressures to 300 lbs. steam, 600 lbs. air. Reduced pressures to a low of 1 lb.

• Varied pressure control obtained without change of springs.

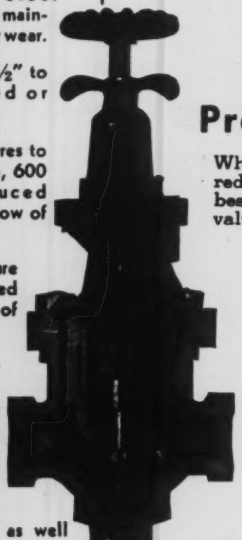
• Available in various combinations for pressure control, temperature control, single unit pressure and temperature regulation as well as constant pressure pump governors.

• Completely interchangeable parts for comparable sizes.

Control reduced pressures more accurately!

KECKLEY

Pressure Regulators



Where you have to maintain ACCURATE reduced pressures for air or steam, your best bet is a precision pressure regulating valve from Keckley. These valves feature a highly sensitive diaphragm and spring design that gives dependable automatic compensation for fluctuating initial pressures, for constant reduced pressures that you can depend on. Standard stainless steel unit pilot valve, main valve and seat can be removed easily for inspection. Here is a valve that is rugged, dependable and unbelievably economical to maintain.

Standardize on Keckley for the best in pressure regulators.

Send for your copy of this catalog—53-D

O. C. KECKLEY COMPANY

400 W. Madison St. • Chicago 6, Ill.

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Pocket Pyrometer

The Cybertronic Model 240-T Pocket Pyrometer measures $3^3/_7$ in. × $3^1/_2$ in. × $1^3/_4$ in. and has a 2.4-in. direct-reading indicator scale. Quick and accurate measurement of surface and sub-surface temperatures is claimed through the use of interchangeable thermocouples. Model 240-T is encased in a shock-absorbing rubber case. The pyrometer is available in five standard ranges.

Full information is available from Cybertronic Corp. of America, 136-8th St., Dept. B-31, Upland, Chester, Pa.

Flow-Control Valve

Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has designed a valve said to be usable to replace either troublesome gate valves that require frequent manual opening and closing, or diaphragm valves.

The new Golden-Anderson Cushioned Flowtrol Valve may be moved to the fully open or tightly closed position by moving a small pilot cock or by operation from remote-control stand. The Flowtrol valve can be used on water, oil, air, and many liquids, on pressures ranging from 15 psi to 400 psi, and is available in sizes 2 in. through 36 in.

Design and construction features, along with complete parts list, dimensions, and specifications, are described in a four-page bulletin. Copies of this Bulletin W-8 can be obtained from Golden-Anderson Valve Specialty Co. 2113 Keenan Bldg., Pittsburgh 22, Pa.

Rotary Shaft Seal

The HHB Improved Rotary Shaft Seal offers operating advantages in hand-operated electrical circuit and tuning mechanisms for radio and radar communication equipment for ships, aircraft, and mobile ground equipment. Designated as Series 1100, the rotary shaft is said to be especially valuable in connection with pressure, waterproofing, and moisture-sealing panel-mounted shafts.

Three standard sizes are available. Modified designs can be created to meet special requirements. Inquiries regarding special applications for pressure, or waterproofed, rotary shaft seals should be sent to H. H. Buggie, Inc., 726 Stanton St., Toledo 4, Ohio.

Vacuum Impregnation

A revised edition of a 24-page brochure on "Vacuum Impregnation" has been released by F. J. Stokes Machine Co., Philadelphia, Pa. The new publication describes in detail a range of applications for this process, by which voids in porous materials are filled with a desired impregnant after air and moisture have been evacuated. Among these uses are the sealing of metal castings against micro-porosity, the improvement of dielectric efficiency in electrical components, and the potting of transistors.

The enlarged range of Stokes equipment for vacuum impregnating is described and specifications for standard cylindrical and rectangular impregnating chambers, storage tanks, and vacuum pumping units are contained in the booklet, designated Catalog No. 760.

Copies of Catalog No. 760 may be obtained free on request to F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa.

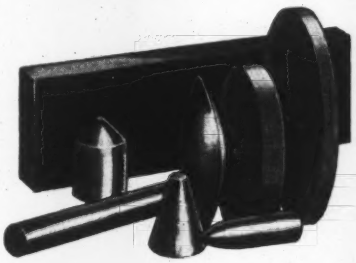
Reduce Labor Costs — Speed Production with

CRATEX

The World's Finest

RUBBERIZED ABRASIVES

"cushioned action performance"



There are over 160 standard sizes and shapes of Cratex Rubberized Abrasives available to meet your needs in

BURRING, SMOOTHING and POLISHING operations

Manufactured in four "grit types" from coarse to extra fine, Cratex saves production and labor costs by doing one or more operations at one time—such as Cleaning, Blending, Lapping, Finishing, and Trimming—on hard or soft

METALS, PLASTICS, GLASS and scores of other materials.

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—are ideal for manual or machine application—require no special equipment—always ready for instant use. For over 30 years, Cratex has served industry with unparalleled results — an unduplicated reputation for lowering "unit costs" in burring, smoothing and polishing operations. Investigate Cratex Rubberized Abrasives . . . "The World's Finest For Industrial Use" . . . send today for Descriptive Catalog which gives full details, applications and prices.

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Material Handling

Transportation and material handling is emphasized in the July 1953 issue of *Production Road*, published by the Twin Disc Clutch Co., Racine, Wis. Paving equipment, drilling for oil, fork-lift trucks, logging, shipping, and aircraft are among the applications listed and described. Copies can be obtained on request.

Alloy Clad Steel Fabricating

Two data summaries on alloy clad steel have been issued by the Lukens Steel Co.

Advanced techniques for fabricating clad steels are outlined on a wall-mount chart. The "Clad Fabrication Data" chart gives basic information for arc-welding and flame-cutting clad steel plates. Of interest to designing, engineering, and shop personnel of steel fabricating companies, and useful to equipment design groups, it is intended to be hung in the shop or office for ready reference. Copies of the chart can be obtained by writing Manager, Marketing Service, Lukens Steel Co., Coatesville, Pa.

Conversion tables and theoretical weights for clad steel plates are assembled on a new information card.

These reference tables, said to be the most complete yet published covering clad steel conversion data, include, in addition to conversion tables, an inch-equivalent-for-sheet-thickness table for AISI manufacturers' standard gage steel sheet; U. S. standard gage stainless, nickel, Inconel, and Monel sheet; and for Browne & Sharpe gage copper, brass, and aluminum sheet. Also included are conversion factors to determine the weight of solid alloys, or certain non-ferrous plates.

Copies of the tables are obtainable by writing Manager, Marketing Service, Lukens Steel Co., Coatesville, Pa.

Carbon-Graphite Material

The United States Graphite Co., Div. of The Wickes Corp., Saginaw, Mich., has announced publication of a 66-page illustrated catalog containing full information about Graphitar, a material for seals, bearings, end plates, valves, piston liners, and many other parts.

Graphitar is produced from carbon and graphite powders, compacted under pressure and furnaced at temperatures exceeding 3000 F. It is lighter than magnesium, harder than most steels, and mechanically strong and durable, the manufacturer states. Graphitar is self-lubricating. It is a conductor of electricity, and is chemically inert and will not corrode even when exposed to most concentrated acids. Graphitar can be formed in relatively complicated shapes and ground to tolerances as close as 0.0005 in.

The new catalog describes the manufacture of Graphitar and lists its characteristics and physical properties. A section is devoted to special manufacturing limitations and tolerances that must be considered when designing. Detailed operation information is included together with instructions for shrink-fit and press-fit assembly of Graphitar parts in metal housings. A pictorial section, illustrated with photographs and engineering drawings, shows numerous applications. A list of other products of The United States Graphite Co. is appended.

Copies of the Graphitar Catalog can be obtained without cost or obligation by writing to the company in Saginaw, Mich.

Heat Unlimited

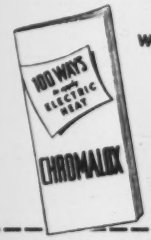
FOR EVERY PRODUCTION NEED!

Yours with

CHROMALOX

Electric **HEATERS**

Need heat for production or processing? Chromalox Electric Heaters are your quick and economical answer. Over 15,000 types, sizes and ratings to choose from to give working temperatures up to 1100° F. Temperatures controlled precisely by either manual or automatic thermostatic controls. No steam-lines, no boilers or expensive equipment to install!



WRITE FOR

Handbook "100 Ways to Apply Electric Heat." It suggests many uses for Chromalox Electric Heaters.

EDWIN L. WIEGAND CO., Industrial Division
7646 THOMAS BLVD., PITTSBURGH 8, PA.
Send me the illustrated booklet "100 Ways To Apply Electric Heat" 18-37-A

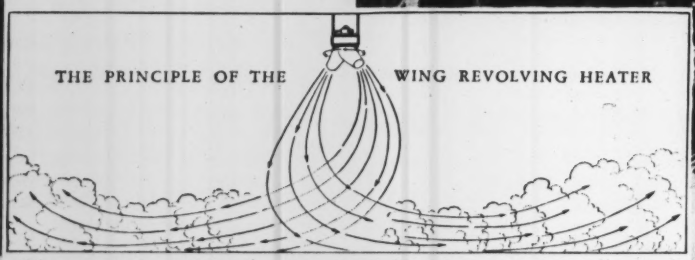
Name _____
Company _____
Street _____
City _____ Zone _____
State _____
I use heat for _____

CHROMALOX

THE BEST IN ELECTRIC HEAT

HEAT THAT MOVES AROUND

THE fact that the discharge outlets of WING Revolving Unit Heaters keep the heated air in constant, gentle motion is one of the reasons why nationally known firms like the Budd Company have installed them in their plants, both at Philadelphia and in the one shown in this photograph, at Gary, Indiana. The big blanking and forming presses in this great plant present a natural barrier to ordinary fixed discharge heating systems, but not to the moving streams of heated air from the WING Revolving Heaters, even suspended, as they must be, far above the floor, to clear the cranes. That is equally true in the summer time when, with steam turned off, the cooling breezes from the revolving discharge outlets keep workers comfortable on the hottest days. Investigate. Write for Bulletin HR-6.



The moving streams of heated air (or cooling breezes in summer) sweep slowly around through 360 degrees, covering successively every direction. The air velocity is sufficient to carry to walls, and remote corners and the constantly changing direction of flow causes the air to find its way around obstructions.

Wing

L. J. Wing Mfg. Co.
156 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N.J. and Montreal, Can.
In Europe: Etab. WANSON, Brussels, Belgium

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Radiant-Convection Furnaces

Petro-Chem Bulletin 53-1 describes the Isoflow Radiant-Convection Furnaces. The Isoflow design consists of an upright cylindrical steel structure with an integral self-supporting stack. The inside of the cylindrical casing is lined with insulation, which in turn is protected by a layer of insulating refractory brick to form the combustion chamber. A circle of vertical tubular heating elements is placed in the cylindrical combustion chamber and burners are installed in the floor of the furnace so that all tubes are equi-distant from the flame burst. A central re-radiating cone is located at the upper end of the combustion chamber.

Uniform heat transfer rates are claimed by the subjection of the heating surface nearest the flame burst to a controlled amount of radiant heat while the upper sections of the heating surface are subjected to varying proportions of direct radiant, secondary radiant, and convection heat. Copies of this bulletin can be obtained by writing to the Petro-Chem Development Co., 122 East 42nd St., New York 17, N.Y.

Centrifugal Blowers

Billmyre Blower Div., Lamson Corp., Syracuse, N. Y., has published Bulletin B-6 which catalogs products of the division. The two-color, 32-page bulletin includes information on centrifugal blowers and exhausters for air or gas handling.

Typical applications of Billmyre blowers are illustrated and described. Air blowers and exhausters are available with either cast iron or fabricated steel housings. Performance data is presented for air blowers and exhausters with heavy-duty cast iron housings ranging from 1 psi to 7 psi; air blowers and exhausters with heavy-duty fabricated steel housings from $^1/_2$ psi to 3 psi; and gas blowers or boosters with heavy-duty cast iron housings for gas pressures from $^1/_2$ psi to 6 psi, with specific gravity ranges of 0.55 to 1.40.

Technical data is included on: agitation of liquids; air for combustion; air for foundry cupolas; ice making; vacuum cleaning; and pneumatic conveying. Fundamental engineering laws for blower applications are given, as well as altitude and temperature correction factors, pressure equivalents, and friction-loss and velocity tables. Copies of Bulletin B-6 are available directly from Lamson Corp., Syracuse, N. Y.

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Low-Voltage Control Systems

A new 16-page picture-story bulletin describing Cabinetrol low-voltage control systems has been announced as available from the General Electric Co., Schenectady 5, N. Y.

Designated as GEA-3856, the two-color publication uses more than 35 pictures to explain the construction, installation, and protective features of the control units. Reference and selection charts on the 24- and 40-in.-deep models are included for squirrel-cage, synchronous, and wound-rotor motor controls as well as for lighting panelboards, lighting single-phase circuit transformers, incoming-line and feeder units, and for automatic throw-over units.

A three-step method of planning a Cabinetrol installation and the specifications of the units also are discussed in the bulletin. Complete dimension diagrams for both types are included.

D-C Motors and Generators

The Louis Allis Co. has recently prepared and released a 16-page bulletin covering its line of d-c motors, 1/2 to 300 hp, and d-c generators, 3/4 to 250 kw. The bulletin is illustrated with photographs and cutaway drawings, which show details of d-c mechanical construction, available d-c motor enclosures for different operating conditions, d-c motor applications, and several special d-c designs engineered and built by Louis Allis. The bulletin also includes a section on motor-generator sets for converting alternating current to direct current in industrial service.

Text and diagrams also give a description of d-c electrical characteristics and show the features, advantages, and applications of shunt, series, and compound motors. Motor-starting information is included, as well as a section on d-c adjustable-speed applications.

Copies of the bulletin, No. 1450, may be obtained from any Louis Allis district sales office or distributor or by writing the Louis Allis Co., Milwaukee 7, Wis.

Belt Conveyor Idlers

More than 500 belt conveyor idlers in 34 types, designed to meet practically every requirement, are pictured and described in a 48-page Book No. 2416, just released by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill.

Light-, medium-, and heavy-duty 20-deg troughing idlers, two styles of 45-deg idlers, flat belt, belt training, rubber cushion and the new Link-Belt variable troughing idlers are included, all in a broad range of roll diameters and belt widths, together with return belt idlers and such accessories as idler stands, grease pipe extensions, and a grease seal and bearing extractor.

Detailed information is provided for selection and spacing, based on weight and lump size of material to be conveyed. Schematic drawings and dimensional data are included for each type of idler.

Book 2416 introduces a Link-Belt variable troughing idler on which the angle of inclination of the concentrator rolls is adjustable to provide smooth belt transition between troughing idlers and flat pulley. Copies are available on request.

For Consulting Engineers Turn to Page 142

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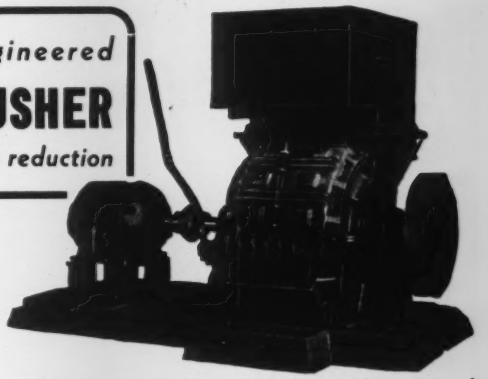

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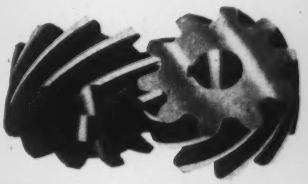

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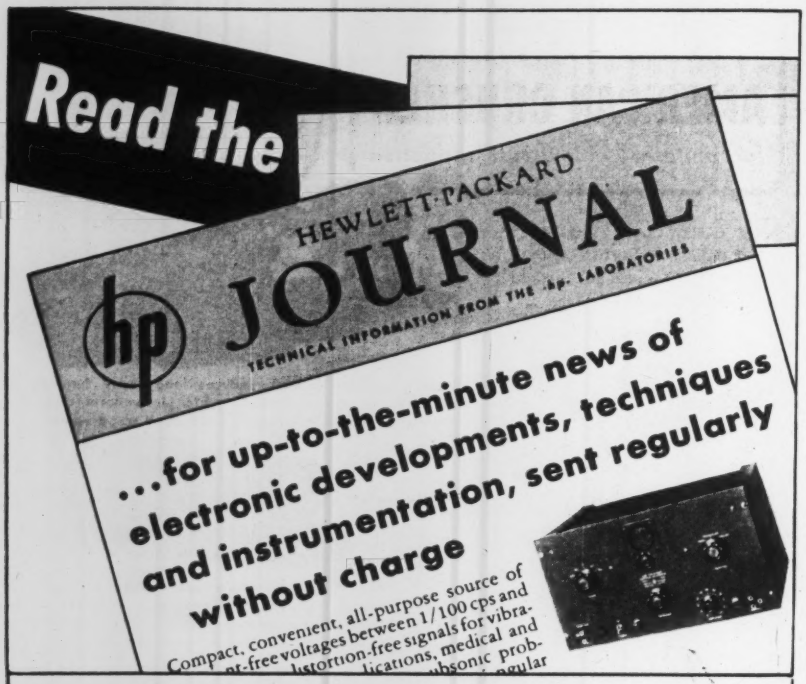
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INSTRUMENTS FOR COMPLETE COVERAGE

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Pumping-Heating-Straining Units for Fuel Oil

Bulletin 16-H illustrates Schutte & Koerting's new packaged units designed to provide straining, heating, and pumping of Bunker C, or other grades of fuel oil, to oil burners.

Components of the SK "Packaged" Duplex Pumping, Heating, and Straining Units include: duplex suction and duplex pressure strainers; pumps; heaters; thermostatic control valve; relief valves; gages; thermometers; and other accessory equipment. Copies of Bulletin 16-H are available from Schutte & Koerting Co., Dept. P-F, Cornwells Heights, Bucks County, Pa.

Photo-Recording

Techniques of Photo-Recording from Cathode-Ray Tubes, Third Edition, is a review of the problems and associated solutions encountered in photographing cathode-ray patterns. It is a 36-page manual offered by Technical Sales Dept., Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

The manual is illustrated with actual photo-recordings, scales, graphs, and diagrammatic sketches. In addition to technique information, the manual contains descriptions and specifications of the Du Mont line of photo-recording equipment. The manual is offered to qualified personnel requesting copies on business letterheads.

Cemented Carbide Tools

Kennametal, Inc., Latrobe, Pa., has released several technical reports on the performance of its products. Report of Kennametal Performance No. 433 concerns the reduction in tool cost by using Kennamatic solid ground insert tools in turning 5-in. H.E. projectiles. Report of Kennametal Performance No. 434 discusses increased speed of machining mounted railroad wheels by using Kennametal clamped tools.

A reprint from *Steel*, "Contouring Takes on the Heavyweights," by Patrick H. Gribbin, Kennametal engineer, discusses heavy metal-removing in contouring. "Economic Factors Must Govern Wheel Selection for Grinding Carbides," by F. J. Lennon, Jr., Kennametal general superintendent, is a reprint from *American Machinist*. The article discusses problem of costs in grinding carbides. Copies of any of this literature is available from Kennametal, Inc.

Liquid Filters

A bulletin describing its line of Micro-Klean Filters, for liquid applications, has been published by the Cuno Engineering Corp., Meriden, Conn. The products described include standard models for flows between 1.8 gpm and 900 gpm. Maximum operating pressures of standard units range from 125 psi to 1000 psi. Higher operating pressures are available upon request. Featured in the bulletin is the recently announced graded-density cartridge. Applications, standard dimensions, case histories, and a selector chart, to be used as a guide for choosing the proper filter under normal conditions, are included.

A full page of hydraulic data covering such items as viscosity conversion tables, hydraulic formulas, dimensional comparisons (mesh, inches, and micronic) and representative micronic comparisons is included. The 12-page bulletin, No. MK-0553, is available from the company.

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Psychrometric Thermometers

A four-page catalog describing the installation and application of pairs of fluid-filled temperature elements for indicating or recording relative humidity, or both, is now available. Covering installation of natural-circulation, blower-circulated, and porous-sleeve psychrometers for both open and closed systems, the catalog includes a psychrometric table for use in interpreting dry- and wet-bulb readings to values of relative humidity. The catalog is free on request for Catalog 12-A-20 from Fischer & Porter Co., 819 Jacksonville Rd., Hatboro, Pa.

Packaged Adjustable-Voltage Drives

Packaged adjustable-voltage drives for variable-speed applications are covered in a 16-page booklet available from the Westinghouse Electric Corp. The first of its kind, this booklet gives complete information about this adjustable voltage drive; construction and operation, typical applications, and the economics of operation are discussed.

Special operational characteristics that can be added to the standard package, such as inching, reversing, dynamic braking, and multi-motor control, are described, and case histories of these AV drives in the machine tool, textile, and continuous-processing industries are cited. A copy of this booklet, B-5808, can be obtained from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Aluminum-Foil Packaging

A new, revised, and enlarged edition of "Reynolds Aluminum-Foil Packaging" has been published by Reynolds Metals Co., 2500 South Third St., Louisville 1, Ky. A basic treatise on foil packaging, this publication aims to familiarize the packaging engineer with the great variety of foil materials presently used. It also provides in reference form technical data on package design and application.

The 68-page packaging manual is divided into five sections, begins with a brief discussion of the development of aluminum foil, details packaging trends and functions, and analyzes the general properties of aluminum foil for packaging.

Next is a general outline of how aluminum foil is combined with paper, plastics, and fabrics to provide a wide range of packaging materials. Tables present physical properties and performance characteristics of these various composite materials. Packages and package components are then broken down, analyzed, and classified according to design factors.

The following section points out the requirements of packages for various types of applications and correlates the correct aluminum foil packaging material with these requirements. The final section of this booklet contains special additional material, such as data on factors affecting photoelectric registration, when printing, and on gluing of labels. A glossary of terms is also included.

"Reynolds Aluminum-Foil Packaging" is available without cost to packaging engineers and technical men who request it on company letterhead. To others, the price is $1.00 per copy. Address Reynolds Metals Co., 2500 South Third St., Louisville 1, Ky.

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Reducing Valves

New small-flow bronze or steel reducing-valves for steam, air, gas, or liquid service have been added to the reducing valves of Leslie Co., described in new Bulletin 511-A.

The valves have a variety of applications in molding plants, pilot-plant operation, laboratory units, sterilization plants, and other fields where small flows are a problem. The reducing valves handle inlet pressures to 1000 psi and reduced pressures from 2 to 400 psi. Complete capacity tables for four sizes of controlling valves from $^{3}/_{32}$ in. to $^{5}/_{16}$ in. are included in the new bulletin to facilitate sizing. Bulletin 511-A is available from Leslie Co., 144 Delafield Ave., Lyndhurst, N. J.

Torque-Converter Transmission

Western Gear Works, 417 Ninth Ave. S., Seattle 4, Wash., has announced the availability of a new technical bulletin entitled "Pacific-Western Torq-Master Transmission."

The bulletin explains in detail, with drawings and application photographs, how the Torq-Master unit is designed for application to Torque-Converters and how it can be adapted to Pacific-Western Converters and other leading makes. A free copy of this bulletin No. 5328 may be had, without obligation, by writing to Mr. Paul Forsythe, Manager of Sales and Engineering, Western Gear Works.

Index Table

The latest issue of the Denison Press features the Denison Index Tables for use on presses and other machines. A cutaway view assists in the description of the operation of the index table, and three typical cases are described. Use of the index table in staking, riveting, milling, and broaching, are discussed and the advantages of the new table high-lighted.

The index table is supplied in two sizes: 21-in. diameter, which has a work circle for mounting fixtures or dies of 14 in., and 33-in. diameter, with a 24-in. work circle. Both are available for either 6- or 12-station indexing. Copies of this issue of the Denison Press, Vol. 3, No. 8, are available from the Denison Engineering Co., Columbus, Ohio.

Blowdown Practices

An article entitled "Correct Blowdown Practices Can Help Avoid Operating Difficulties" is carried in Vol. 22, Issue No. 3, 1953, of the Armstrong Trap Magazine, published by Armstrong Machine Works, Three Rivers, Mich.

The article discusses definitions of foaming, priming, and carryover; their effects, causes, and avoidance through blowdowns; and the types of blowdowns. Curves and tables show the effect of blowdowns on the concentration of solids, cost data on manual blow-off, recommended allowable solids concentration, and heat recovery with and without flash tank.

Other articles concern humidification in cold storage rooms; solvent filter venting utilizing Armstrong air relief traps; Armstrong ball float traps; and the calculation of air discharge through an orifice.

Copies are available on request from Armstrong Machine Works.

Welded Floats

W. H. Nicholson & Co. has published Bulletin No. 753, a concise detailed catalog of Nicholson Welded Floats. The construction of the floats is described, float shapes are illustrated together with the various float connections available, and tables of list prices, weights, buoyancy, and collapsing pressures are included. A discussion of volume and bouyancy factors and calculations concludes the catalog. The floats are available in spherical, elliptical, and cylindrical shapes of chrome-, copper-, or cadmium-plated steel, stainless steel, and Monel. The bulletin can be obtained from W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.

Portable Power Tools

Syntron Co., 498 Lexington Ave., Homer City, Pa., has just released a new catalog, identified as Catalog No. 537, illustrating and describing its line of portable power tools.

It includes descriptive information and specifications on the Syntron electromagnetic hammers and hammer drills, and the line of portable electric drills, screwdrivers, nut runners, polishers, sanders, and grinders. Information is also included on the new electric impact wrench which Syntron has made available recently.

Similar information on the line of self-contained gasoline hammer paving breakers and rock drills together with concrete vibrators of both the form and flexible-shaft mass type have also been included. A copy of the catalog is available upon request.

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Office Copying Machine

A leaflet picturing the new Kodak Verifax Printer is now available from the Eastman Kodak Co. The leaflet gives full details on this new "companion to the typewriter," which will produce three copies of any written, drawn, or printed material up to $8\frac{1}{2} \times 11$ in. in size within one minute. The cost, when three Verifax copies are prepared from the same matrix, is less than five cents each, Kodak states.

The Kodak Verifax leaflet may be obtained by writing Industrial Photographic Sales Div., Eastman Kodak Co., Rochester 4, N. Y.

Inside Adjustable Gages

A new booklet has been issued to illustrate the Barnaby Inside Adjustable Gages for tool room, inspection, and production department use. Designed for use for inspection of inside diameters and checking bell-mouth and out-of-roundness, Barnaby Gages come in standard sets or individually, and are available in sizes $\frac{3}{8}$ in. to $1\frac{1}{2}$ in. Prices for the individual gages and for the sets are shown.

Also explained is the Barnaby Speed Gage which is an inspection gage originally developed by Barnaby to facilitate production gaging in war industries. It is a non-perishable, wide-range Speed Gage, according to the manufacturer. Prices and specifications are also given.

Inquiries should be sent to Barnaby Mfg. Co., Inc., 74 Knowlton St., Bridgeport, Conn.

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Ion Exchangers

To summarize the properties of most of their ion exchangers and indicate some of their uses, a 12-page bulletin, No. 2508, has been prepared by The Permutit Co., New York 36, N. Y.

Ion exchangers are being utilized for the removal of impurities from solution; concentration of electrolytes in solution; addition of specific ions to solution; separation of electrolytes in solution; catalysis and in special medical applications.

The bulletin details a general history of ion-exchange engineering, gives data on the proper selection of ion exchangers, and lists general applications in the treatment of water and special problems associated with the recovery of valuable metals from solutions, streptomycin purification, sugar refining, separation of rare earths, treatment of wastes, etc.

Measuring Equipment

A revised edition of the General Electric Co.'s 64-page measuring equipment catalog, containing information on more than 115 testing and measuring devices for laboratory and production line use, has been announced as available from the company at Schenectady 5, N.Y.

The fully illustrated publication, GEC-1016A, contains information on products ranging from simple current-indicators to completely automatic oscillographs; from surface-roughness scales to mass spectrometers; from d-c amplifiers to radiation monitors.

The purpose of the catalog is to bring to the attention of its users the many measuring devices that can be used to increase the efficiency of their operations. A brief description of each product and its field of application, condensed tables of important characteristics, and prices indicate whether or not the device is suited for a specific job. Reference to more complete bulletins on each type of equipment also is included.

Miniature Ball Bearings

A new 20-page bearing catalog has been published by Miniature Precision Bearings, Inc., Keene, N. H. The three-color, $8\frac{1}{2} \times 11$-in. booklet presents information on ball bearings in sizes ranging from 0.100-in. OD to 0.375-in. OD. Technical data is supported by drawings, graphs, tables, and photographs.

The catalog contains data on all MPB products, including radial, angular contact, pivot, and thrust bearings. All radial bearings, with and without retainers, and with flanged outer races, are fully described. Data also covers the super-light radial series specified when maximum shaft diameters are required.

A complete page is devoted to each bearing description, which includes an identifying photograph, a scale drawing showing actual bearing sizes available, a load-speed graph, and a dimension chart with cutaway drawings to identify legends.

The first five pages illustrate and describe applications where miniature bearings have proved helpful. The catalog also describes the company's engineering service and the availability of special bearings of many types.

The final four pages present design factors involving miniature bearings, discussing load rating, speeds, tolerances, clearances, and lubrication.

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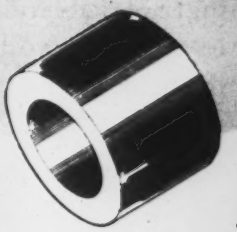

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Coarse vs Fine Threads

Heli-Coil Corp. has announced the availability of a four-page bulletin No. 662, entitled "Which Thread..... Coarse Or Fine?", a reprint from *Fasteners*, official publication of the Industrial Fasteners Institute.

Factors discussed in the reprint are: torque effort, adjustment of bolt tension, loosening in vibration, load distribution on successive threads, static tensile strength, fatigue strength, corrosion resistance, control of blank for threading, damage in handling, stock simplification, and ease of assembly.

The reprint is available without cost from Heli-Coil Corp., 1387 Shelter Rock Lane, Danbury, Conn.

Cone-Drive Gears

The extent to which double-enveloping worm gearing has helped improve design, performance, service-life, and saleability of all types of equipment in recent years is illustrated in a 36-page, two-color booklet now available from Cone-Drive Gears Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. Bulletin CD-173, titled "Cone-Drive Gears At Work In Industry," documents 93 successful applications in 20 different industrial classifications ranging through the alphabet beginning with agricultural equipment and extending to zinc mining.

Standard Cone-Drive Gears are available in a wide range of sizes. Standard center distances from 2 to 18 in. provide horsepower ratings up to 800 hp. Ratios range from 5:1 to 4900:1.

Arc Welding Procedures

A reference table designed to help fabricators of tubular materials has been published by the Tubular Products Div. of The Babcock & Wilcox Co. Known as "Summary of Recommended Arc Welding Procedures for Various Steel & B&W Croloy Combinations," it outlines pertinent details to be observed in joining similar and dissimilar alloys by arc welding. It covers carbon steels, intermediate chromium-molybdenum-alloy steels, and stainless steels, and outlines the electrodes to be used and suggests the preheating and postwelding heat treatments to be employed in obtaining satisfactory results. The data card, TDC-155, is available without charge upon request to the division's general sales offices at Beaver Falls, Pa.

Deaerator

Construction features of the Allis-Chalmers American jet tray deaerator, Type K-114, which is used in power plants to remove corrosive gases from boiler feed water, are described in new literature released by Allis-Chalmers Mfg. Co.

According to the four-page leaflet, the deaerator offers a combined advantage of a spray-type, direct-contact, first-stage heater performing as an efficient direct contact vent condenser and primary deaerating mechanism, a second-stage steam jet atomizer, and a final tray-type deaeration section with reboiling action.

Copies of the literature, "New Allis-Chalmers American Jet Tray Deaerator Type K-114," 28R7980, are available on request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

ANNOUNCING

the inclusion of the memoirs of two distinguished engineers in the ASME BIOGRAPHICAL SERIES

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These autobiographies are warmly recommended for their vivid portrayal of two pioneers at work and for the interesting picture they reveal of expanding technology in two important fields.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th St., New York 18, N.Y.

Crane Scales

Typical applications of Baldwin SR-4 crane scales and indicating or recording instruments for weighing loads electronically are described in Bulletin 4105, a new 8-page, illustrated brochure issued by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

The new bulletin shows how these scales, utilizing the principles of the SR-4 bonded resistance wire strain gage, are installed and used.

Industrial Filtration

A new eight-page brochure by the U. S. Hoffman Machinery Corp. presents the essential features and applications of their ten basic types of industrial filtration equipment. These include disk-, cartridge-, and pressure-type filters, flotation units, vacuum stills, magnetic separators, and oil conditioners. Purpose of the equipment is to reclaim and repurify oils, coolants, solvents, and industrial waters by removing solids, solubles, and volatile contaminants on a continuous automatic basis. Free copies may be obtained by requesting Bulletin A-943 from U. S. Hoffman Machinery Corp., Industrial Filtration Div., Thompson Rd., Syracuse 6, N.Y.

Measuring Instruments

"Instruments for Modern Measurements" is the title of a new 34-page book printed in two colors by Brush Electronics Co. It illustrates and describes over 37 different instruments, especially engineered and produced for electrical measurements, physical measurements, resistance-welding measurements, textile measurements, ultrasonic energy applications, electro-accoustical measurements, etc. Several new instruments are included as well as improved models.

Booklet will be sent free of charge to those sending letterhead request to Sales Promotion Dept., Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Centrifugal Blowers

Billmyre Blower Div., Lamson Corp., Syracuse, N. Y., has published Bulletin B-6, which catalogs products of the division. The two-color, 32-page bulletin includes information on centrifugal blowers and exhausters for air or gas handling.

Typical applications of Billmyre blowers are illustrated and described to indicate the wide variety of uses for this equipment. Air blowers and exhausters are available with either cast iron or fabricated steel housings.

Performance data is presented for ai blowers and exhausters with heavy-duty cast iron housings ranging from 1 psi to 7 psi; air blowers and exhausters with heavy-duty fabricated steel housings from $^1/_2$ psi to 3 psi; and gas blowers or boosters with heavy-duty cast iron housings for gas pressures from $^1/_2$ psi to 6 psi, with specific gravity ranges of 0.55 to 1.40.

Technical data is included on: agitation of liquids; air for combustion; air for foundry cupolas; ice making; vacuum cleaning; and pneumatic conveying. Fundamental engineering laws for blower applications are given, as well as altitude and temperature correction factors, pressure equivalents, and friction-loss and velocity tables. Copies of Bulletin B-6 are available directly from Lamson Corp., Syracuse, N. Y.

Packaged Steam Boilers

Packaged steam boilers for oil and combination oil and gas firing are covered in Mkayo Bulletin 7D, published by Mears Kane Ofeldt, Inc., Div. of S. T. Johnson Co., Church Rd., Bridgeport, Pa. The features of the Mkayo boilers and of their component parts is described. Several application photographs are shown. A table of general specifications completes the bulletin, which is available at no charge.

Ventilation and Air Movement

A 64-page illustrated guide to modern industrial ventilation and air movement has been published by Aerovent Fan Co. as their 1953 catalog. Engineering, installation, and operation data for all standard and special-duty fan applications are contained in the book, with pertinent details for calculating duct sizes, friction losses, performance, and horsepower requirements. Full details and description of all Aerovent Fans and accessory equipment are included. Aerovent Fan Co., Inc., 720 E. Ash St., Piqua, Ohio, will send Catalog No. 20—ME on request.

Aluminum Products

"Alcoa Chemicals" is a four-page leaflet describing Alcoa's chemical products. Products covered include Activated, Calcined, Low-Soda, Tabular, Hydrated, and catalyst Aluminas; fluoride; cryolite; and gallium. Uses of these are applicable to many industries: desiccant, dehydrant, catalyst and catalyst-carrier, oil-maintenance, chromatographic, abrasive product, refractory, ceramic, filler, and aluminum chemical production.

"Alcoa Aluminum in the Process Industries" is an eight-page booklet telling of the uses of aluminum in such industries as plastics, soap, cosmetic, drug products, sulfur petroleum, and chemical. The booklet discusses Alcoa products for the processing industries; lists the economic advantages of aluminum; gives tables covering materials handled safely with aluminum, composition and properties of aluminum alloys, and other engineering information.

These two booklets are available from Alcoa Sales Offices or from the Aluminum Co. of America, 808 Alcoa Bldg., Pittsburgh 19, Pa.

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DO YOU WANT | LONG LIFE, EASY MAINTENANCE, RELIABILITY

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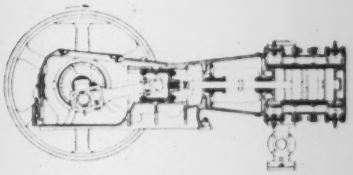
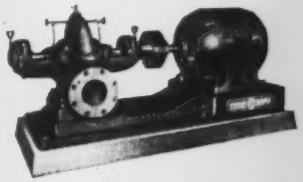
Automatically prevents reverse flow through Compressor and also dampens pipe line pulsations.

This Check Valve should be on EVERY reciprocating Compressor. Bulletin 509-H



OILFREAIR and OILFREGAS Compressors guaranteed to compress air or gas free of any trace of oil or oily vapors. They are unequaled for Instrumentation, Food and Chemical processing. Bulletin 202-H, 600-H



PENNSYLVANIA Double-Suction, Single-Stage Centrifugal Pumps. Available in sizes 1½ to 14 inches to handle 20-7000 GPM for pressures to 130 psi. Bulletin 233-5-H

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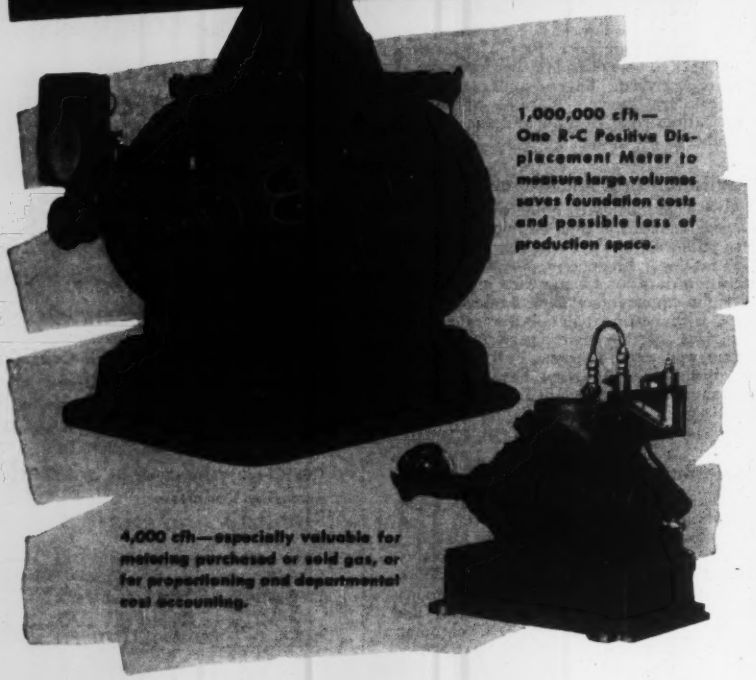
CALL ON THE "Specialists" FOR ACCURATE METERING


1,000,000 cfh—
One R-C Positive Displacement Meter to measure large volumes saves foundation costs and possible loss of production space.
4,000 cfh—especially valuable for metering purchased or sold gas, or for proportioning and departmental cost accounting.

The successful performance of Roots-Connersville Positive Displacement Meters has long been proved by large and small industrial plants and public utilities. These users rate them high in such basic essentials as:

Accuracy—not affected by pressure, wide ranges in loads or other variables. Absence of valves, vanes and other small parts insures "cash register" accuracy over years of use.

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A new bulletin, M-152, gives complete data on R-C Meters, including a handy selection table which simplifies your choice of the right meter to suit your specific application. Your copy will be sent on request.

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Exclusive Specialists in Handling Gas and Air

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Combustion Systems

Peabody Engineering Corp., 580 Fifth Ave., New York 36, N; Y., makers of burners, scrubbers, and air heaters, has recently released a four-page two-color bulletin on a series of complete combustion systems that they have installed in and around metropolitan New York. While not detailed, the bulletin does give before-and-after pictures of several installations, including the Astor Hotel, West Point Military Academy, and Gimbel Brothers.

Pneumatic Controller

Fischer & Porter Co. has published a four-page Catalog 53-11, describing the new Fischer & Porter Field-Mounted P4 Pneumatrol pneumatic controller. Features of the controller claimed by the manufacturer are: interchangeability with case-mounted design, remote three- or four-pipe installation, superior high-frequency response, small size, and availability of all control functions.

A working sketch is shown, together with diagrams of three-line and four-line field-mounted systems. The advantages of field-mounted control are discussed. Copies of the catalog are available from Fischer & Porter Co., 841 Jacksonville Rd., Hatboro, Pa.

Stamped Gears

The Winzeler Mfg. & Tool Co. has published a bulletin on their stamped gears, including spur gears, crown gears, spur and pinion, racks, internal gears, external gears, segment gears, pinions, and sprockets. The gears are available in 16 to 96 diametral pitch.

The bulletin contains a table of rules and formulas for spur gears, and a table of tooth parts. An insert gives diametral pitch, number of teeth, nominal pitch diameter, central bore, and material thickness for 16-d.p., 24-d.p., 32-d.p., 48-d.p., 56-d.p., and 80-d.p. spur gears, $14^1/_2$-deg pressure angle, and for crown gears and 48-d.p., 20-deg pressure angle, spur gears. The bulletin is available on request from the Winzeler Mfg. & Tool Co., 1712 West Arcade Pl., Chicago 12, Ill.

Sprockets and Roller Chain

The Dodge Mfg. Co. has published Bulletin A-624, "Taper-Lock Sprockets and Dodge Roller Chain," a 24-page catalog.

One page is devoted to Taper-Lock Sprockets for each size of chain from No. 40 through No. 100 inclusive. Each page includes cross-section drawing, dimensions, number of teeth, list prices with and without bushings, sprocket number, bushing number, maximum stock bore available, weight of sprocket with bushing, and price list of chain in that size.

Condensed on one page is the following data relating to Taper-Lock bushings for these sprockets: cross-section drawing, dimensions (both sprockets and keyseats), prices, weights, and stock bores. Full information is given on Dodge roller chains, both riveted and cotter types. In addition, one page is devoted to roller chain pin extractors.

Five pages of selection data for roller chain drives include tables of service factors, horsepower ratings, calculation of chain length, center distances, and speed ratios. Installation, adjustment, lubrication, and maintenance information is also given. Copies can be obtained from the Dodge Mfg. Co., Mishawaka, Ind.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Oil Burners

The Ray Oil Burner Co. has published a condensed 16-page catalog listing commercial and industrial oil and combination gas-oil burners, including: fully automatic, semi-automatic, and manually controlled horizontal rotary and steam-turbine drive burners; commercial and domestic pressure atomizing types for oil, gas, or combination gas-oil. Specifications and capacities are given. Copies are available from Ray Oil Burner Co., 1301 San Jose Ave., San Francisco 12, Cal.

Deaerating Heaters

A new bulletin on spray-type deaerating heaters has been published by Graver Water Conditioning Co., manufacturers of water treating equipment for boiler plants, industrial and process services, and water supply.

The bulletin explains the specific functions and requirements of deaerating heaters, describes their design and operation in detail, and outlines the accessory equipment for best results. The illustrations include sectional drawings and representative installation photographs of both horizontal and vertical designs, together with flow charts of units in typical applications.

Copies of this informative bulletin can be obtained by addressing Graver Water Conditioning Co., Dept. 21, 216 West 14th St., New York 11, N. Y., and asking for Bulletin WC-101A.

Chimney Repair

A leaflet on the prevention of chimney failure through maintenance and repair has been released by the Consolidated Chimney Co., 8 South Dearborn St., Chicago 3, Ill. A number of photographs including before-and-after pictures show the results of inside corrosion, and the repairs that have been made by Consolidated in numerous plants throughout the country. Copies can be obtained from the Consolidated Chimney Co.

Industrial Instruments

How Standard Oil of Indiana keeps more than 36,000 instruments, valves, and control devices in operating condition is a featured story in the second quarter 1953 issue of *Instrumentation*, publication of the Minneapolis-Honeywell Regulator Co., Industrial Div.

Other articles in the issue concern the steam power set-up in Holyoke, Mass.; the use of instruments in the manufacture of roller and ball bearings; a Canadian sulfuric acid plant; instruments for guided missiles; a British steel company; weight measurement by means of a strain gage; control valves; the selecting, installing, and maintaining of thermocouples and extension wire, and a humorous history of how the pressure gage got its name.

Copies are available on application to Minneapolis-Honeywell Regulator Co., Industrial Div., Station 64, Wayne and Windrim Aves., Philadelphia 44, Pa.

Drafting Machines

A new drafting machine booklet has been printed by the Charles Bruning Co., 4700 Montrose Ave., Chicago, Ill. The two-color booklet presents a mechanical description of the various drafting machine models including gravity-compensated, track-type, civil engineering, and detail machines.

Entitled "The Finest in Drafting Machines", the new booklet features detailed illustrations, and also pictures and describes the latest types of scales for all uses.

Air Handling Units

A six-page bulletin describing the features of a complete line of air handling units for industrial and commercial heating, ventilating, and air conditioning applications is available from the Westinghouse Electric Corp.

The bulletin describes the three outstanding characteristics of the units as being heavy welded construction, quiet operation, and efficient, stable performance. Detailed installation possibilities are also given for central-plant air conditioning, exhausting heat fumes or vapors, and heating and ventilating requirements where cooling is not needed.

A full line of accessories is described including humidifiers, mixing boxes, and filter sections.

Bulletin 1600 can be obtained from Westinghouse Sturtevant Div., Dept. T-071, 200 Readville St., Hyde Park, Boston 36, Mass.

● At Western Piping Supply, the men who weld, align, heat treat and test all have special qualifications for their particular tasks. Most, also, have many years of service with the company.

This combination of skill and experience spells out uniform quality in every job, from job to job, year in, year out. It's a good reason why WPS enjoys an exceptionally high customer repeat rate, and good reason, too, why you should specify WPS when you want superior quality piping.

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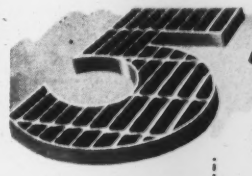
FABRICATORS OF CARBON AND ALLOY PIPING



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We factory-fit this one-piece Open Steel Flooring to your dimensions for easy installation. You can cover dangerous open areas and add useful space inside and out.

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BLAW-KNOX ELECTROFORGED STEEL GRATING

American Blower

Unit Heaters

It takes only a few minutes to learn how much better your heating can be with American Blower Unit Heaters.

And, for years after you install them, you'll get the benefits of their lower fuel costs, lower maintenance costs and exceptionally long life.

Heavy-duty coils, unobstructed outlets for maximum heat diffusion, completely enclosed moving parts are but a few of the quality features which make these units outstanding. They carry Certified Ratings — and are sound-rated, too.

For data, phone the nearest American Blower Branch Office.

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CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

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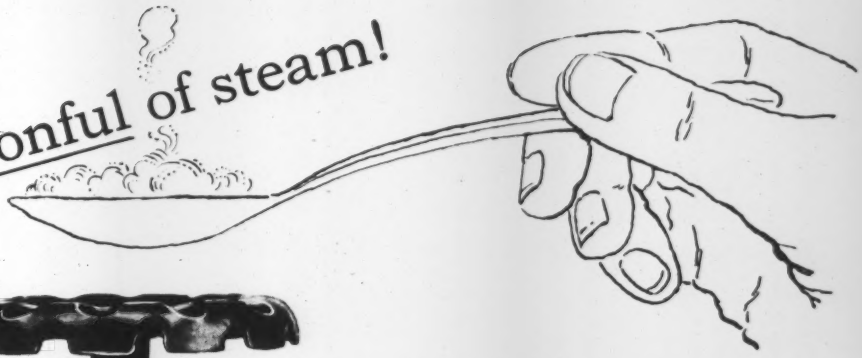
YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

a teaspoonful of steam!



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a NEW LESLIE REDUCING VALVE

for accurate, foolproof regulation of small flows of steam, air, gas or liquids, with inlet pressures to 1000 psi and reduced pressures from 2 to 400 psi.

Change operating conditions quickly and easily with simple, handwheel adjustment —no need to waste time changing springs or swapping parts. Check these widely accepted Leslie features that are standard in the new, efficient, Leslie Small Flow Reducing Valve.

Check these features

- Simple, compact construction
- Top quality materials
- Metal Diaphragm
- Entirely enclosed—no stuffing boxes
- Corrosion resistant springs
- Hardened stainless steel valve
- Interchangeable inner valves

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Before you order—

The new Class LCB is just one of the many units that are *special* with most manufacturers but are *standard* with Leslie.

Check to see if any pressure, temperature or level control you want is standard with Leslie, before you order. Play it safe. Your Leslie Engineer is listed under "Valves" or "Regulators" in the classified telephone directory in principal cities.

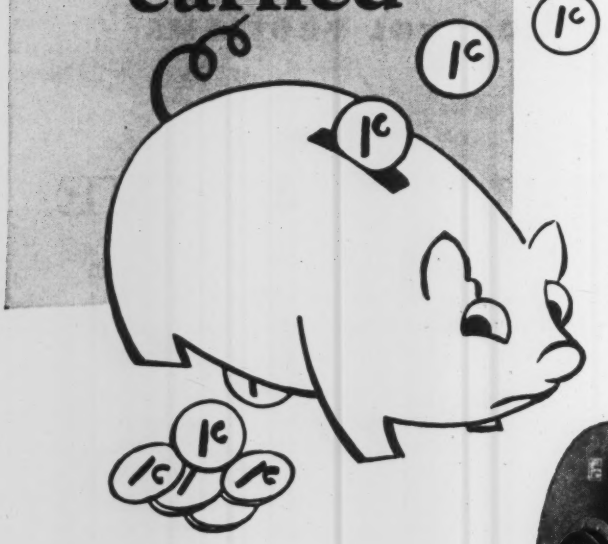
LESLIE

THE FIRST NAME IN PRESSURE, TEMPERATURE AND LEVEL CONTROLS

Since 1900

LESLIE CO., 287 Grant Avenue, Lyndhurst, New Jersey

Pennies saved are not always pennies earned



Take the case of the man who saved a few dollars on air handling equipment, which he expected to use for many years. Installation costs turned out to be high and maintenance expense excessive—more than he saved on original purchase price. Of course, not every low bidder has an inferior product; but you can be sure of one thing: if a high quality product is to meet all low bids, the quality just can't stay high! We at "Buffalo," with seventy-six years of top quality manufacturing behind us, call your attention to the "Q" Factor.* Without it we could not have maintained the performance records chalked up in many of America's outstanding industrial plants. We have no intention of abandoning the practice of building the best possible product and pricing it afterwards.

*—*The "Q" Factor —The Built-in quality which provides trouble-free satisfaction and long-life.*

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Complete lines, the Jubilee Breezo, an efficient disk fan—the "LL", a non-overloading centrifugal, the Axial Flow, and many others for all services including forced and induced draft fans.

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Full lines of industrial air cleaning equipment for gases and fumes, as well as air washers and cabinets for air conditioning.

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PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

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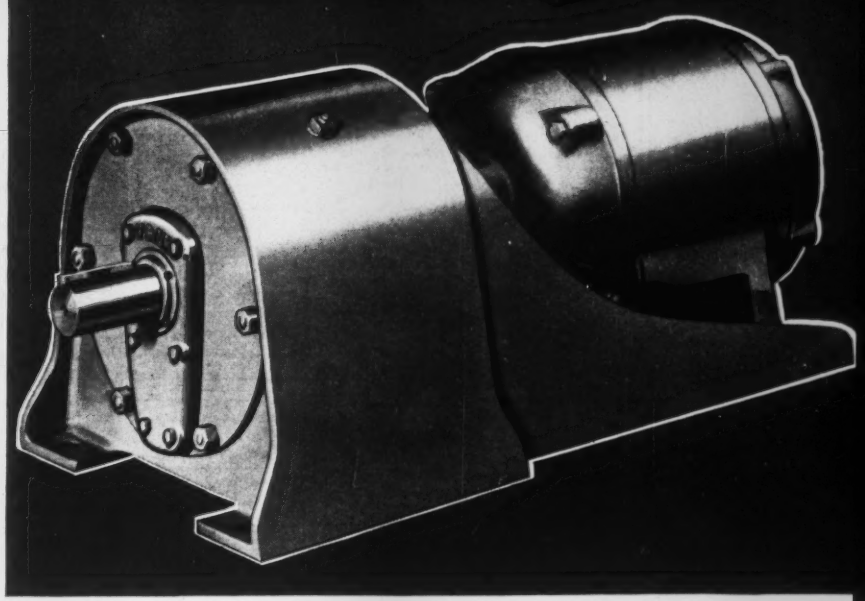
VENTILATING FORCED DRAFT | AIR CLEANING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT PRESSURE BLOWING | EXHAUSTING

Incorporate the All-[illegible] type,

ALL-STEEL FALK Motoreducer

as your standard!

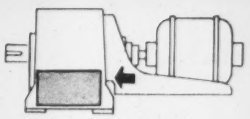


Meet customers' specifications without change in your basic drawing

The *all-steel,* All-Motor type FALK Motoreducer assembly can easily be modified to use overload protective coupling, brake-wheel coupling, multispeed transmission or hydraulic fluid drive. Motors with variable speed drive arrangement can be substituted for standard motor.

The All-Motor type FALK Motoreducer . . . the only complete and compact motorized reducer with a separately mounted, resilient Steelflex coupling-connected motor . . . enables the user to replace motors from his spare stock or other convenient source as required, *in minutes*—on the job!

Any make, speed, or type of standard foot-mounted motor within the unit's rating may be used (or interchanged) without modification of gear unit. Ratio of unit can be changed without modifying the motor. Ease of motor replacement and ratio change reduce over-all cost of any equipment-remodeling desired by the customer. Write for Bulletin 3104.



Every FALK Motoreducer has these "In-built" Factors—

Positive Lubrication. Large sump capacity . . . oil-tight construction assures clean lubricant . . . direct dip of revolving elements provides positive lubrication at all speeds.

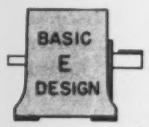
Wide Speed Range. Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

Streamlined inside and outside. Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

Sealed Housings. Dual closures and one-way vents keep oil *in*, dust and moisture *out*. Units are splash-proof, leakproof, dustproof.

Precision Gearing. Heat treated alloy steel, precision cut and shaved helical gearing throughout . . . quiet-operating crown shaved pinions . . . taper bored gears for easy ratio changes.

All-steel Housings. Unbreakable, strong, rigid. Generous overhung load capacities provided by wide bearing spans, large shafts and bearings.



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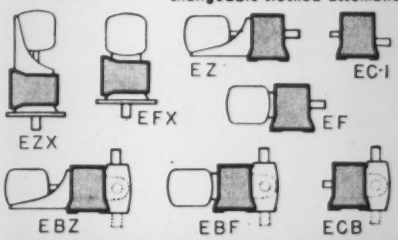
The basic E design permits maximum use of standardized parts . . . closer control over materials, processing, inspection and assembly . . . resulting in faster delivery from interchangeable stocked assemblies.



FALK ... a good name in industry

THE FALK CORPORATION · 3001 W. Canal St. · Milwaukee 8, Wis.

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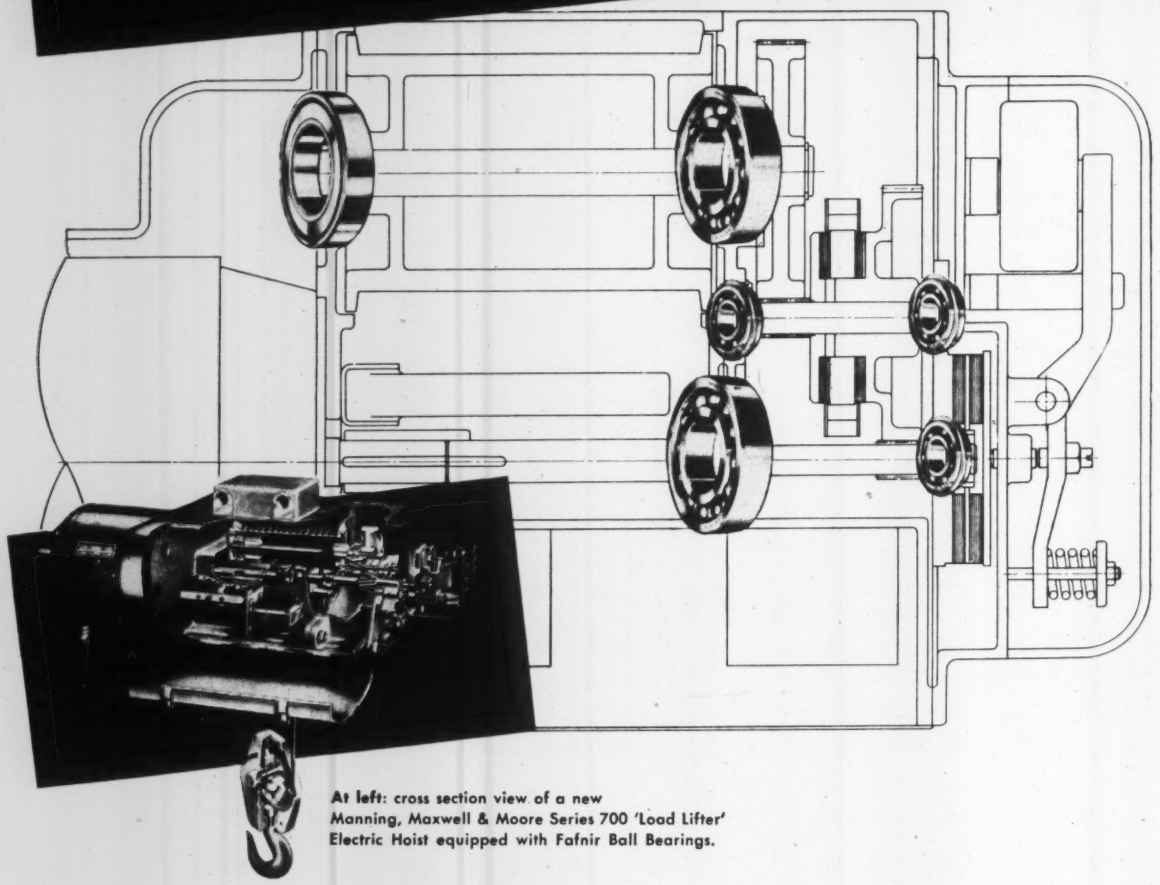
How an "Industrial Muscle" is kept from getting "Muscle-bound"



At left: cross section view of a new Manning, Maxwell & Moore Series 700 'Load Lifter' Electric Hoist equipped with Fafnir Ball Bearings.

Every bearing indicated in the diagram above highlights the strategy of Manning, Maxwell & Moore's electric hoist designers. Each eliminates a possible source of trouble caused by friction ... on rope drum (bearing lubricated for life) on trolley assembly, on gear shafts, etc.

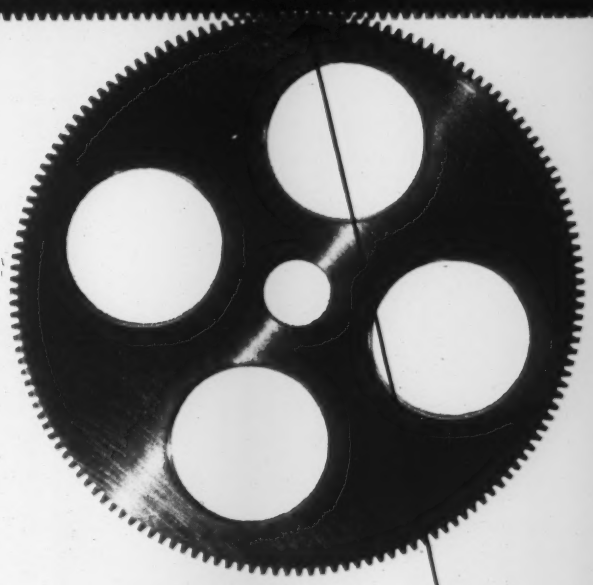
With critical turning points protected, this heavy-duty 1-ton capacity hoist is offered for three-shift lifting *every day in the year*. It lifts a ton, thirty feet a minute. Power is concentrated on lifting, not shared to overcome friction. It's smooth, steady, and efficient. Lubrication becomes a minor detail.

Fafnir is a supplier of Ball Bearings for Manning, Maxwell & Moore hoists and for hundreds of other industrial machines where Ball Bearing advantages improve performance and prolong service-life. The choice of Fafnir Ball Bearings, in case after case, has been influenced by the Fafnir "attitude and aptitude" . . . a way of looking at bearing problems from the designer's viewpoint, an aptitude for supplying the right ball bearing to fit the need. Maybe these attributes can help you solve a bearing problem. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR **BALL BEARINGS**

MOST COMPLETE LINE IN AMERICA

Why you can *reduce rejection losses* with a Kodak Conju-Gage Gear Checker



Why the composite check

In practice, the final test of gear quality is how the gear works in use. The composite check recommended in American Standard B6.11-1951 shows this conclusively by measuring displacement of the gear when run against a master of known accuracy. And it does it in one quick operation that checks combinations of as many as six types of errors.

Why the Conju-Gage Gear Checker

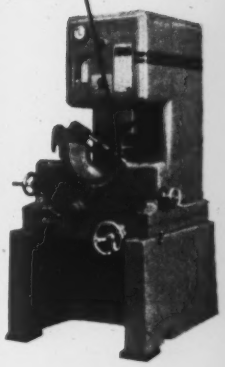
Since displacement represents the sum of both gear error and error in the master, the accuracy of the master used determines the precision of the composite check. The Kodak Conju-Gage Gear Checker uses a master of exceptional accuracy, the Conju-Gage Worm Section. Produced by thread grinding, its accuracy is not limited by the same manufacturing processes which limit accuracy in the gear itself.

To settle for masters of lesser accuracy is to rob yourself of "tenths"—to chance that tolerable error in a gear may coincide with error in the master to cause a needless rejection. Or that intolerable error in a gear may be cancelled by error in the master to pass a gear that will fail in use.

To reject every wrong gear is to guard the quality of your product. To pass every right gear is to reduce such rejection losses to a minimum.

To find out more about how a Kodak Conju-Gage Gear Checker can lower costs while maintaining required precision, send for your copy of the booklet, "Kodak Conju-Gage Gear Testing Principle." Write to

Special Products Sales Division
EASTMAN KODAK COMPANY, Rochester 4, N.Y.



The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variations, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 8U, for gears up to 8¼" pitch diameter. Smaller models are also available.

CONJU-GAGE INSTRUMENTATION

. . . a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak

Vibration Engineering that solves your problems

PROBLEM: To locate vibration and measure it

SOLUTION: This sensitive, velocity-type MB Vibration Pickup

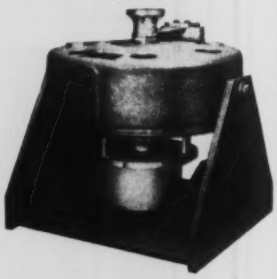
Illustrated here is the MB Type 122 Vibration Pickup developed for jet engine testing. It withstands 500° F.

To LICK VIBRATION you've got to *locate* it first. That's a job for which the MB Vibration Pickup was developed. It has the sensitivity needed to detect the faintest vibration—the stamina to withstand the strongest.

When fastened to the product, component or structure under test, this pickup faithfully converts vibratory motion into elecrical output. Its signal can be seen and studied on the oscilloscope; or measured by meter such as the direct-reading MB Vibration Meter; or fed to vibration analyzer.

The pickup is usable from 5 to 2000 cps in horizontal or vertical operation. Magnetic damping assures calibration stability. Lightweight moving coil and low-friction pivoting account for the pickup's wide range of serviceability.

Today, this unusual instrument is being found indispensable for accurate vibration detection. It's one more reason why MB is known as headquarters for the answers to vibration problems—including those in shake testing, measurements, vibration isolation and shock mounting. Full details on pickups in Bulletin No. 124-4. Write us.



Double duty vibration exciter

Specification MIL-E-5272 and other vibration testing specifications can be met with the Model C-1 Shaker. It develops 50 pounds of force. An electromagnetic shaker, it features easy, continuous control of force and frequency. It also serves as a calibrator for vibration pickups.

The technique of calibration has been thoroughly presented in MB's booklet entitled "The Calibration of Vibration Pickups to 2000 cps." Send for Booklet C-11-4.

THE MB MANUFACTURING COMPANY, INC.
1060 STATE STREET, NEW HAVEN 11, CONN.

PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION • TO MEASURE IT • TO REPRODUCE IT

Electronic spacer patterns guide stockpile through sequence of cuts automatically. Responsive Oilgear Transmission provides speedy travel with pin-point stopping within 3/1000ths of an inch from zero tolerance. Lawson Cutter also used in repetitive single cuts and for trim on sides. Photo in plant of Liedtke Brothers, Chicago.

The RESULT?

Accuracy just 900% better

Production increase 50 to 500%

Over and over and over again, Oilgear Fluid Power proves to be the right solution to a drive problem. Take the case of the Lawson Cutter.

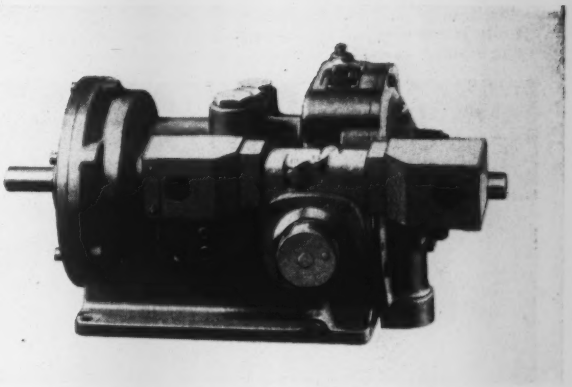
If precision is emphasized anywhere, that "where" is the field of fine color printing of every description. Money, time, effort are spent that art be right, that plates be right, that printing be right—to a hairline. And then comes the cutting operation where all that has gone before is saved—or wasted. Small wonder that cutting remained a hand operation for many years.

But the E. P. Lawson Company, manufacturer of cutting machines, wanted to modernize and mechanize the operation. Its designers turned to an electronic spacer device. This if anything would give precision in marking *where* to cut. But the next problem was to find a power drive capable of *obeying* the orders the electronic signal system was capable of *giving*. Lawson tried one type of drive. It varied all over the map. Lawson tried another type of drive. It was fairly accurate —but did not hold up.

Finally, as so many machine designers have done, Lawson turned to Oilgear. And there, as so many machine designers have done, Lawson found the answer to its problem.

The answer? Undeviating accuracy within 3/1000ths of an inch from zero tolerance—just 900% better than what had been achieved in the past; speed, translating into production increases of 50% to 500% month in and month out. How? Through the absolute responsiveness of Oilgear Fluid Power Drive to the automatic control system. Immediate, shockless acceleration to full speed "forward". Precise measured slowdown as the feed fence nears the target. Precision stopping "on target" for the cut and then rapid acceleration toward the next cut.

Here again is an example of the superlative "right-



Oilgear Two way Variable Speed Transmission as used on Lawson Electronic Spacer Cutters. These drives also provide unlimited speed range from zero to maximum. Speed changes made in split second or specified time.

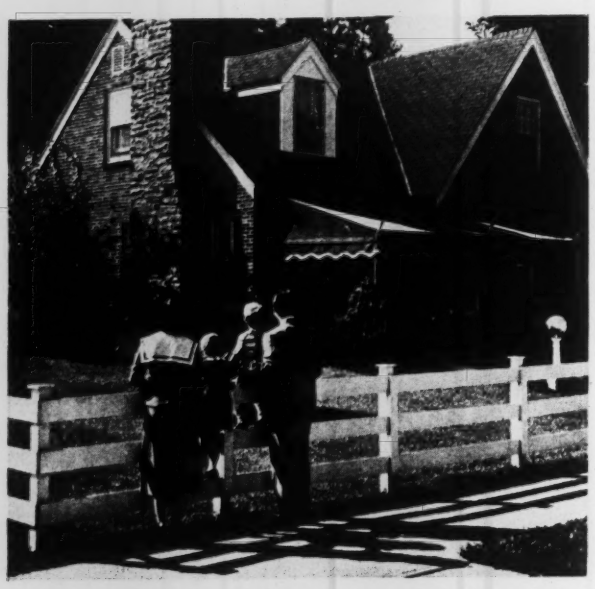
ness" of Oilgear Fluid Power "generators," motors, transmissions—for almost any type of installation or machine requirement, big, little, and all those in between.

Chances are Oilgear is *the* solution you've been looking for. And Oilgear engineers will be just as quick to tell you if Oilgear is *not* for you. Ask for further information from an Oilgear Engineering Representative. No charge. No obligation. THE OILGEAR COMPANY, 1570 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

How would YOU solve these two problems?



1. FLINTKOTE INSULATED SIDING is saturated with hot asphalt by a continuous conveyor process through a dip tank. Fenwal THERMOSWITCH® Thermostats, connected to pilot lights, warn when asphalt varies from safe operating level. The totally enclosed mechanism of the THERMOSWITCH units is not affected by the high heat (420°F) or viscosity of the liquid.

2. LABORATORY WORK SAVED. Let one Fenwal All-Purpose Laboratory THERMOSWITCH thermostat do the work of many. This unit has a quick-disconnect plug — goes readily from job to job. It provides close temperature control for solids, liquids and gases. Stainless steel shell, resistant to corrosion, shock and vibration.

3. YOU, TOO, MAY BENEFIT from a Fenwal THERMOSWITCH Control.* Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved many types of temperature control problems throughout industry. The external, single-metal shell expands or contracts *instantly* to temperature changes, making or breaking electrical contacts.

*Cartridge Type Illustrated

4. SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write **Fenwal Incorporated, 59 Pleasant St., Ashland, Massachusetts.**

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*

Where continuous flow and maximum capacity are required, use

ZURN DUPLEX GATE-TYPE L-P-D... STRAINERS

Free Floating Valve Disk, easily removed through the valve access cover, insures against binding of valve operating mechanism.
Hinged Cover with "C" Washer Closure and Multiple Basket design facilitates cleaning; permits one man operation.
Operating Screw cannot be damaged by corrosion or foreign particles in the liquid on the inside or by physical damage on the outside of the strainer
Large open area ratio (6 to 1) lengthens cleaning cycle relative to conventional style 2½ or 3½ to 1 open area ratio strainers.
Angle Basket design permits straight-through flow, minimizes pressure drop.

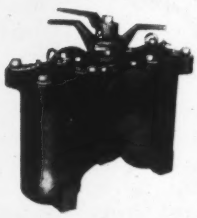
● Design improved for placement of Multiple Catch-Baskets. *This permits straight-through flow which minimizes pressure drop.* Angle Basket design insures complete retention of strained particles when basket is being removed for cleaning. *One man can complete basket cleaning easily, rapidly and at low cost.* Basic face-to-face and centerline-to-base dimensions are favorable for installation in minimum space.

Like all other Zurn LPD Strainers, Duplex Gate-Type Strainers are held at close tolerances for materials, shapes and dimensions assuring the utmost in strength and safety and continuous operation.

Zurn LPD Strainers are widely used to protect close tolerance control devices and delicate mechanisms, also to protect product purity. Zurn LPD Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants and ships. They are available for high temperature and high pressure installations. Zurn Fluid Handling Engineers are available for consultation. Write or wire direct to factory.

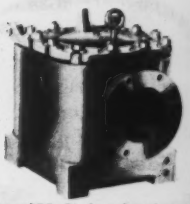
J. A. ZURN MFG. CO.
INDUSTRIAL DIVISION
ERIE, PA., U. S. A.
In Canada: Canadian Zurn Engineering Ltd., Montreal 25, P. Q.

There is a ZURN LPD strainer for every fluid handling purpose


Zurn LPD Duplex Strainer, Plug-Type

Zurn LPD Sinlex Strainer available in offset and straight-through types.

Zurn LPD "Y" Type Strainer available in any cast material and for high pressures.


Zurn LPD Sinlex Strainer, Multiple Basket type, available in several metals and for high temperature installations.

(Zurn Engineered Low Pressure Drop Strainers are patented and patents pending.)

Copyright 1953

WRITE FOR ZURN LPD STRAINER DATA MANUAL NO. 952

This Manual includes *previously unpublished pressure drop data* and gives useful, factual information on fluid handling.

J. A. ZURN MFG. CO. • INDUSTRIAL DIVISION • ERIE, PA., U. S. A.
Please send me Zurn LPD Strainer Data Manual No. 952.

Name _____

Position _____

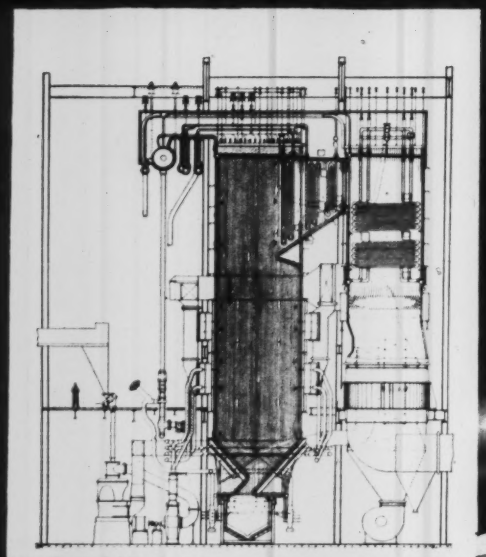
Company _____

Street _____

City and State _____

Please attach coupon to your business letterhead—Dept. ME.

CONTROLLED CIRCULATION at CHESTERFIELD . . .



This Chesterfield boiler serves a 100,000 kw turbine-generator operating at a throttle pressure of 1450 psi with a primary steam temperature of 1000 F, reheated to 1000 F.

. . . meets all expectations

The Chesterfield Power Station of Virginia Electric and Power Company at Wheelwright, near Richmond, Virginia, placed in regular commercial service the first postwar controlled-circulation boiler on December 1, 1952.

Although a completely new design, it achieved ideal performance characteristics from the start, and, with the exception of one scheduled inspection, has been in continuous service ever since. All of the anticipated operating and economic advantages of this new design have been fully realized. It is significant, too, that with new capacity urgently required by the system, the Chesterfield unit was turning out kilowatts just 28 months from the date of order.

The Virginia Electric and Power Company and its designing and construction engineers, Stone & Webster Engineering Corporation, have further confirmed their confidence in controlled circulation by placing orders for three duplicate boilers, two for their new Portsmouth Station and one for their Possum Point Station.

Moreover, leading utility companies now have in service, under construction and on order C-E Controlled Circulation Boilers to serve a total generating capacity of 5,000,000 kw.

Controlled Circulation — pioneered by Combustion in this country for large power boilers — is just one more C-E contribution to American power practice.

B-677

COMBUSTION ENGINEERING, Inc.

C·E

Combustion Engineering Building, 200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

LADISH *Controlled Quality* ASSURES METALLURGICAL SOUNDNESS

SPECTROGRAPHIC ANALYSIS
One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

Ladish measures the spectrum to verify chemical composition

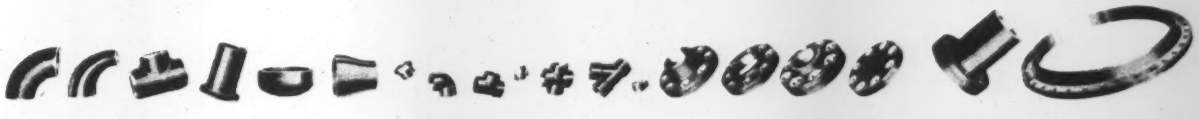
Metallurgical integrity—is safeguarded at Ladish by unsurpassed laboratory controls. Typical is this advanced electronic direct-reading spectrograph. On this unit as many as 300 determinations have been made in one hour to verify compliance of each mill heat with exacting Ladish specifications and, equally important, to assure the absence of detrimental "tramp" elements. Here is but one indication of the thorough, scientific procedures that assure reliability in every Ladish Controlled Quality fitting.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul • St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.



More equipment rusts out than breaks down. Corrosion is a destructive force that every user of fastenings faces.

Many manufacturers today have found that fastenings by Harper mean longer life for equipment, better appearance, well-satisfied customers—because they resist corrosion.

The H. M. Harper Company is the world's largest exclusive producer of fastenings in brass, naval bronze, silicon bronze, monel, nickel, aluminum and all stainless steels. Over 7,000 items in these metals are carried in stock, bringing the advantage of a single source of supply for all fastenings.

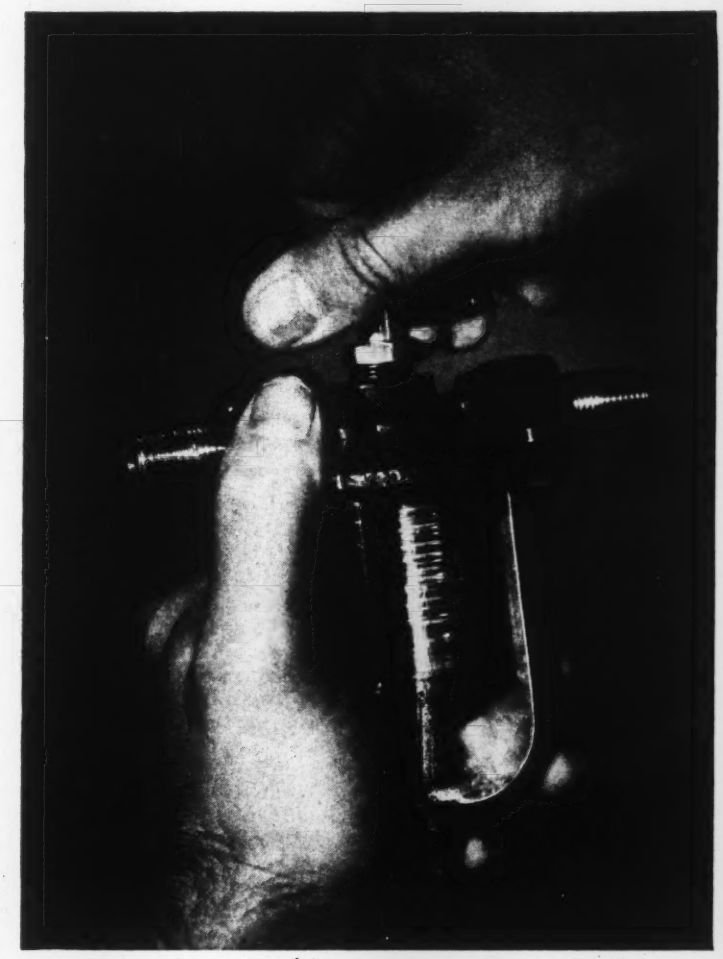
Harper distributors are located in all market areas, and back of these distributors is a complete metallurgical and engineering service, ready to assist in solving any corrosion problem.

THE H. M. HARPER COMPANY
8243 Lehigh Avenue, Morton Grove, Illinois

HARPER

SPECIALISTS IN FASTENINGS

to solve corrosion problems



JUST A twist OF THE wrist

That's all it takes to clean the Cuno AUTO-KLEAN—the strainer that can be continuously cleaned while it's working.

Turning the handle one revolution moves the strainer element through comb blades, removing all dirt from strainer surfaces. Dirt particles fall to bottom of housing, where they can be drained off periodically. Cuno's exclusive combing operation cleans thoroughly—without costly interruption of fluid flow.

- AUTO-KLEAN's permanent metal filter element is available in steel, brass or stainless steel for long trouble-free service under any conditions.
- AUTO-KLEAN is adaptable to any fluid-flow system.
- From acids to tar . . . if you can pump it, Cuno can filter it. Capacities range from one gallon per hour to 3,800 gallons per minute.

A 3.8

CUNO **ENGINEERED FILTRATION**

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

HERE'S HOW TO GET LOW-COST FLUID FILTRATION

Continuously cleanable AUTO-KLEAN eliminates need for stand-by strainers

You don't have to install a duplex strainer system to get all the dirt and other solids out of your process fluids, coolants, chemicals, water, lube oils or hydraulic fluids. A *single* Cuno AUTO-KLEAN strainer will do the job to your complete satisfaction.

This is possible because you don't have to shut down your fluid-flow system to clean this strainer. Cuno's exclusive "comb-clean" action provides complete cleaning of the strainer element on the job—*without stopping fluid flow.* Thus you get non-stop filtration, with no need for a stand-by strainer.

AUTO-KLEAN also saves on maintenance bills, for there aren't any cartridges to change. An occasional rotation of the handle does a thorough cleaning job. (Most units can be equipped with motor-drives for continuous cleaning.)

AUTO-KLEAN is extremely compact. It will give you full-flow filtration in space which would limit ordinary filters to by-pass service. The low pressure drop operation of AUTO-KLEAN permits this full-flow filtration on gravity, low-pressure or high-pressure lines—with no loss in operating efficiency.

AUTO-KLEAN's fixed-space metal discs will stop all solids larger than the specified disc spacing—from .0035" (170 mesh) to .062" (12 mesh).

Find out today about AUTO-KLEAN. Send the coupon for free bulletin.

A.3.14

Cuno Engineering Corporation
Dept. 6514E, South Vine St., Meriden, Conn.

Please send me your free bulletin on Cuno AUTO-KLEAN

for ..... (fluid)

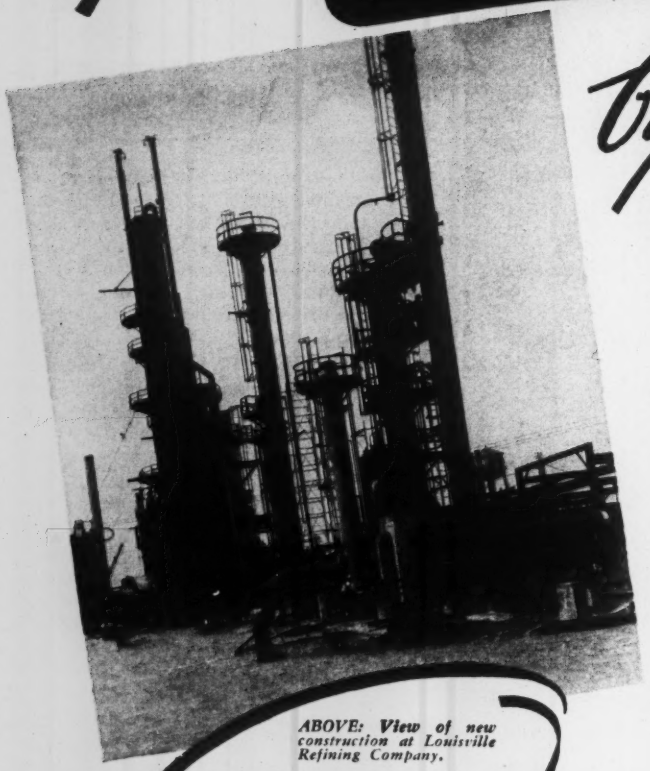
Name .....

Company .....

Address .....

City ..... Zone .... State .....

All SHELL AND TUBE ...HEAT EXCHANGERS by Vogt



ABOVE: *View of new construction at Louisville Refining Company.*

BELOW: *Some of the many Shell and Tube Exchangers.*

Engineered and Licensed by
UNIVERSAL OIL PRODUCTS CO.

At LOUISVILLE REFINING CO.'S New CATALYTIC CRACKING PLANT

Premium gasoline production has been boosted 20% from the same amount of oil charged since the Louisville Refining Company's new Catalytic Cracking Plant went on stream.
The new plant uses Vogt Shell and Tube Heat Exchangers exclusively and they make a significant contribution to the efficient and economic operations of this progressively modern refinery
Vogt Shell and Tube Heat Exchangers are available in many different types, with fixed or removable tube bundles, to meet the special problem and specific operating conditions of each installation. They are constructed from carbon and special steels to meet every temperature, pressure, or vacuum service requirement.

WRITE FOR BULLETIN HE-6

HENRY VOGT MACHINE CO. Louisville 10, Ky. • BRANCH OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, CLEVELAND, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

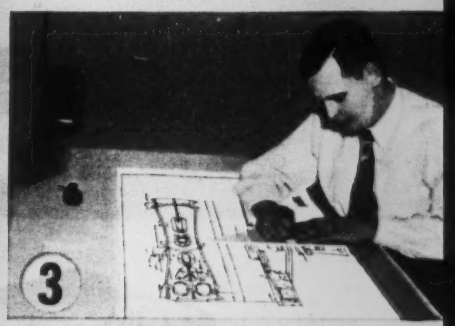
Simple 1-2-3 operation beats the five o'clock deadline

At the Symington-Gould Corporation, Depew, N. Y., extensive revisions are made on drawings of railway specialty equipment... and prints are ready for mailing to customers—hours, even days, ahead of the old schedule.

See how it's done—all so easily—with Kodagraph Repro-Negative Paper . . . another versatile photographic material in the famous Kodagraph line.

A basic drawing—which must be revised to meet the customer's specifications—is exposed on Repro-Negative Paper in a standard print-making machine; then the print is processed in standard photographic solutions. *An easy room light operation* that produces a negative photographic intermediate from the original drawing.

The draftsman obliterates the unwanted detail on the Kodagraph Repro-Negative print by simply applying opaquing ink. The way Symington-Gould figures it, when large areas must be revised . . . or many small scattered changes must be made, this is easier, faster than altering a positive print.



A positive Repro-Negative print is made from the corrected negative . . . on this the draftsman adds the new design . . . and a master is ready to produce the required number of prints. *Ready* in a fraction of the time required previously when the unchanged design was retraced in full.

These Kodagraph Materials also save Symington-Gould time and dollars

- Kodagraph Autopositive Paper is used to reclaim old, soiled drawings; to produce intermediates from customer-drawings on opaque stock.
- Kodagraph Contact Cloth is used to reproduce corrected negative prints when durable, inklike cloth intermediates are desired.
- Kodagraph Autopositive Cloth is used to reproduce new pencil drawings directly, which helps eliminate costly ink tracing.

NOTE: Kodagraph Autopositive Paper and Cloth are processed in the same easy manner as Repro-Negative Paper, but produce positives *directly* from the originals.

Kodagraph Reproduction Materials

"THE BIG NEW PLUS" in engineering drawing reproduction.

Get the full story on the sensational Kodagraph line; learn how you, or your local blueprinter, can process these materials at surprisingly low cost. Write today for a free copy of "Modern Drawing and Document Reproduction."

MAIL COUPON FOR FREE BOOKLET

16

EASTMAN KODAK COMPANY
***Industrial Photographic Division,* Rochester 4, New York**

Gentlemen: Please send me a free copy of your illustrated booklet, "Modern Drawing and Document Reproduction."

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Company_____

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City_____ Zone____ State_____

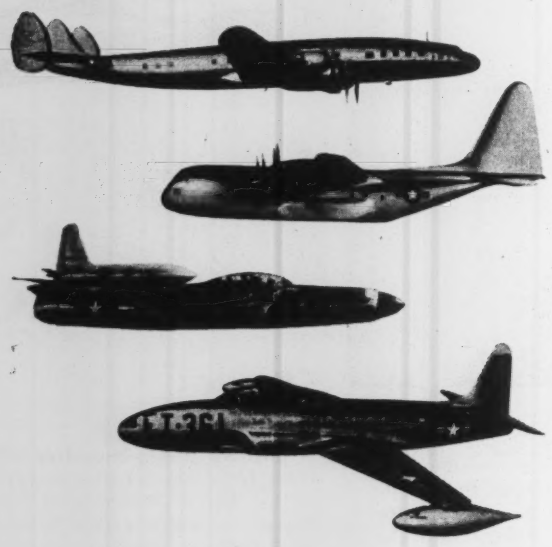
Kodak
TRADE MARK

Three reasons

why Lockheed in California

offers

better careers for engineers



This capacity to develop and produce such a wide range of aircraft is important to career-conscious engineers. It means Lockheed offers you broader scope for your ability. It means there is more opportunity for promotion with so many development and production projects constantly in motion. It means your future is not chained to any particular type of aircraft—because Lockheed is known for leadership in virtually all types of aircraft.

Lockheed's versatility in development and production is also one of the reasons it has an unequaled record of production stability year after year.

1 *Diversified Production*

Huge luxury airliners, cargo transports, fighters, bombers, trainers and radar search planes are rolling off Lockheed assembly lines. Twelve models are in production.

2 *Diversified Development Projects*

The most diversified development program in Lockheed's history is under way—and it is still growing. The many types of aircraft now in development indicate Lockheed's production in the future will be as versatile as it is today—and has been in the past.

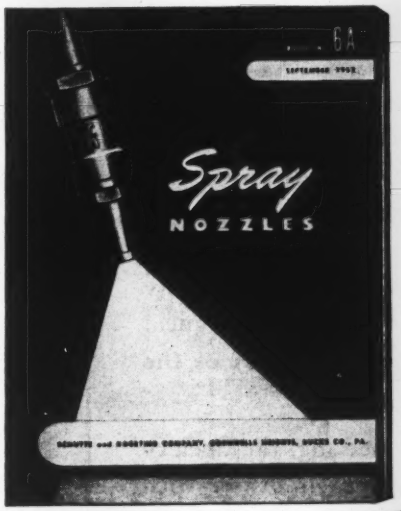
3 *Diversified Living*

You work better in Lockheed's atmosphere of vigorous, progressive thinking—and you live better in Southern California. You enjoy life to the full in a climate beyond compare, in an area abounding in recreational opportunities for you and your family.

Lockheed AIRCRAFT CORPORATION
Burbank, California

ME-9

New SK Bulletin Simplifies Selection of Spray Nozzles



Bulletin 6-A—just issued—contains detailed, concise information on the many types of Spray Nozzles manufactured by SK. It was designed to enable industrial buyers to specify the right nozzle to meet application requirements.

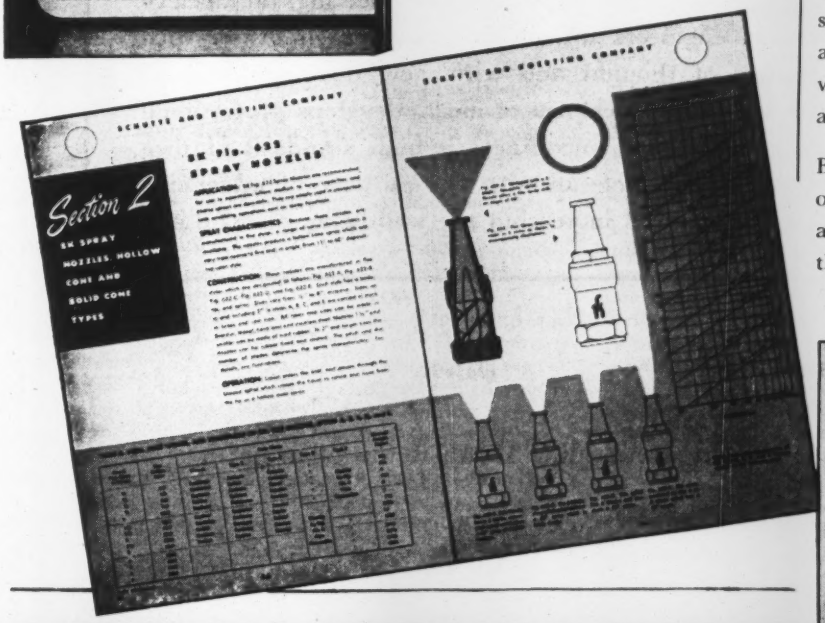
A tabular index in the front of the catalog lists each nozzle by number and gives its primary application, spray characteristic, materials of construction and the page showing detailed description.

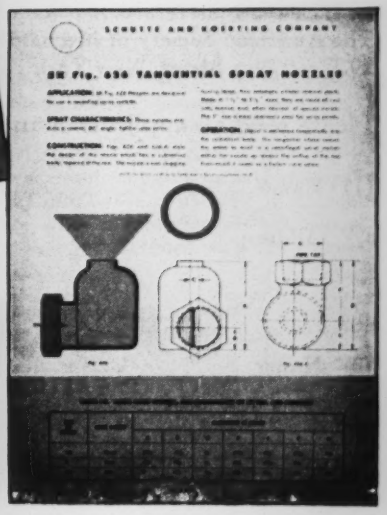
For ready reference, Atomizing Nozzles, Spray Nozzles and Spray Nozzle Clusters are treated in separate sections.

Construction, spray characteristics and capacities are given for each type of nozzle, and differences in design or materials of construction are noted. Descriptive material and illustrations are supplemented by dimension tables and capacity charts.

SK Spray Nozzles are widely applied in mixing, coating, cooling and scrubbing processes. Other typical applications range from atomizing, washing, and aerating liquids to absorbing gases.

Bulletin 6-A is made up of 20 pages of complete, useful material. Request a copy for your files. It's yours for the asking.





SCHUTTE and KOERTING Company

Manufacturing Engineers

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

Date.....

Please send an application and information regarding ASME to the following:

(1) Name.....

Address.....

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(2) Name.....

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(3) Name.....

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Member's Name.....

Address.....

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ME-9-53

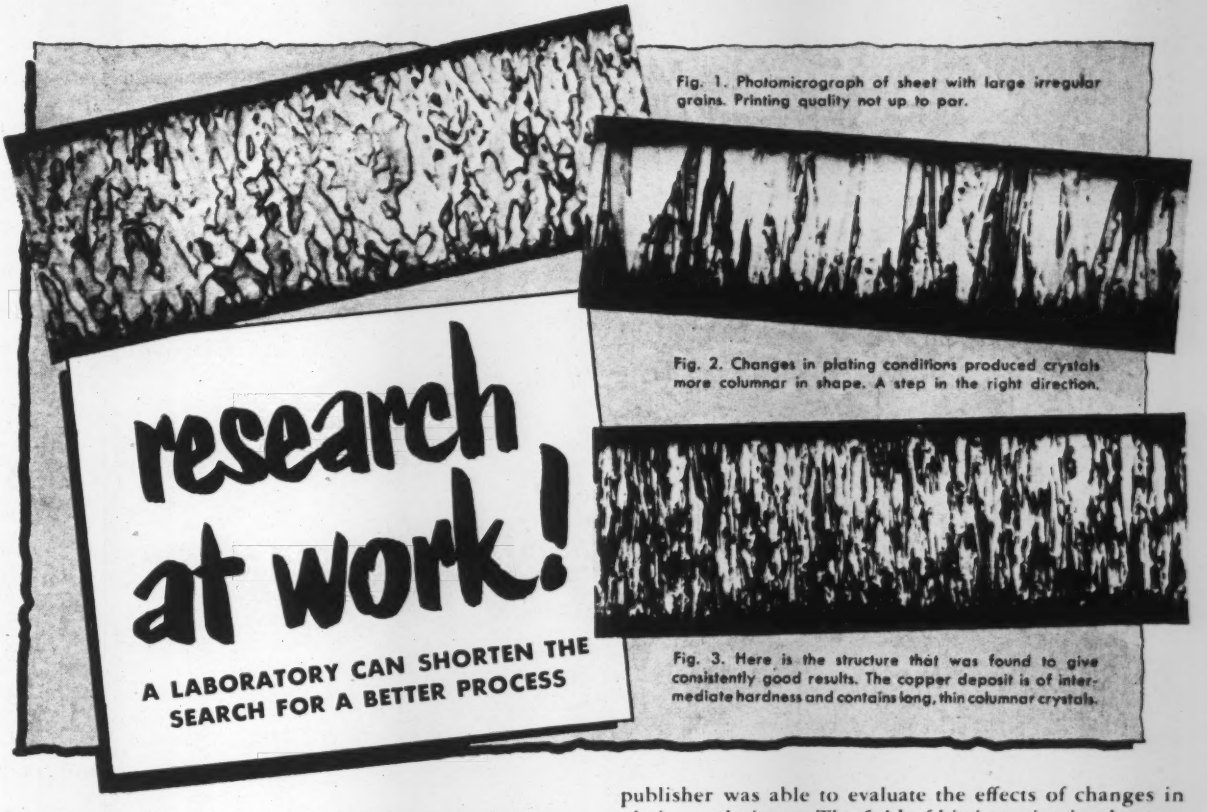


Fig. 1. Photomicrograph of sheet with large irregular grains. Printing quality not up to par.

Fig. 2. Changes in plating conditions produced crystals more columnar in shape. A step in the right direction.

Fig. 3. Here is the structure that was found to give consistently good results. The copper deposit is of intermediate hardness and contains long, thin columnar crystals.

research at work!

A LABORATORY CAN SHORTEN THE SEARCH FOR A BETTER PROCESS

Copper, a basic and important requisite for the printing of Sunday magazines for metropolitan newspapers, has—since the introduction of rotogravure printing process in the United States—suffered from cylinder wear marks which have kept the industry puzzled, and often resulted in defective printing to such an extent that blemishes in printing were easily discernible to the eye—and although not too disfiguring, there remained the necessity for their elimination for the purpose of perfecting the gravure printing operation. In collaboration with a publisher, owner of one of the most modern plants in the world, Revere Copper and Brass solved this perplexing problem and is continuing to contribute to the technical improvement of the rotogravure printing process.

In preparing cylinders for printing roto sections, copper is plated on them before engraving. The electroplating of copper is rather an old process, and its techniques are well understood. By varying current density and composition of the solution, many different types of copper deposit can be obtained. But which of the various methods would give the best results in this case? Rather than engage in a lengthy process of trial and error, the publisher, who felt that the crystal structure of the deposited copper held the key, asked us if we would collaborate.

What Were the Crystals Like?

Sheets of copper resulting from different plating techniques were sent to Research, which not only made photomicrographs of the grain structure, but also determined tensile strength and hardness. As was expected, there were large variations. Some specimens had large and irregular crystals; in others, they were long and thin, like fibers standing on end. In tensile strength, the range was from about 31,000 to 56,000 p.s.i. Diamond Pyramid hardness numbers ran from 62.9 to 141.5.

Over a period of time five different sets of samples were submitted to the laboratory, which made detailed reports on each. By correlating these with his own records, the publisher was able to evaluate the effects of changes in plating techniques. The field of his investigation became narrower after each laboratory report, and in the end it was possible for him to obtain medium-hard, fine grain deposits which require little grinding and polishing. These results now are duplicated daily on a commercial basis. Today the publisher is noted for the exceptionally fine printing quality of his rotogravure sections. The newspaper is The Inquirer, Philadelphia, Pa.

If You Do Not Have a Laboratory

This is an outstanding example of the value of applied research. Many companies occasionally need information that can only be supplied by a laboratory, but are not justified in spending the large sums required to buy and maintain scientific equipment, and to employ qualified research personnel. These firms naturally seek outside sources of the data they require. Revere was glad to cooperate in this instance, because it produces large quantities of copper anodes for plating, and has both the equipment and the experience to make thorough tests of electro-deposited copper sheets or layers.

* * *

The Revere Research Department operates a laboratory that contains the latest scientific equipment, including the spectrograph and X-ray diffraction apparatus. If you feel the need of laboratory work on copper and its alloys, or aluminum alloys, please get in touch with the nearest Revere Sales Office.

REVERE

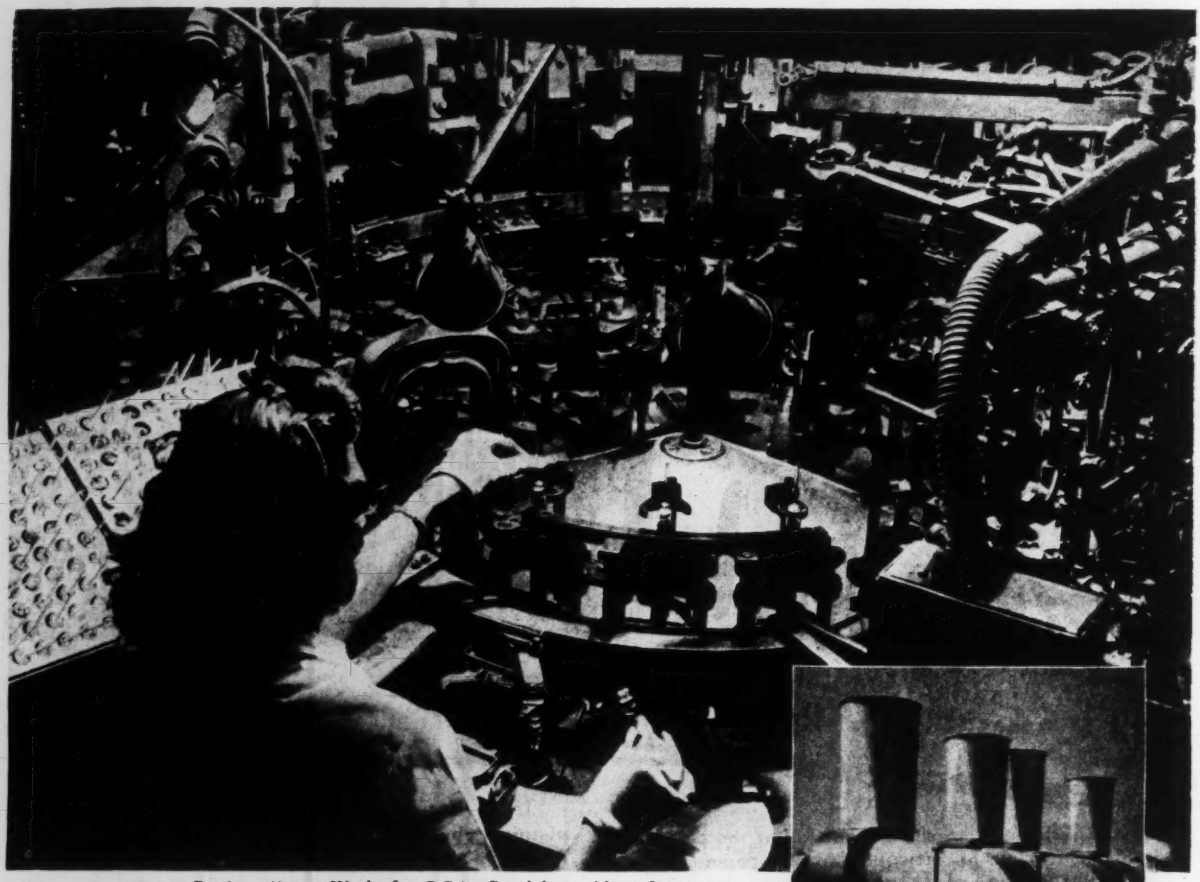
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

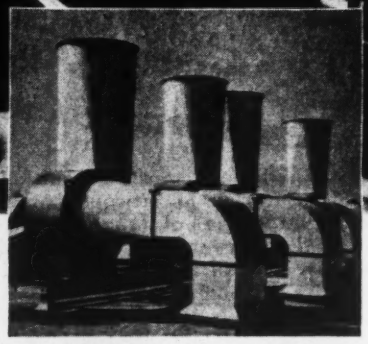
* * *

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities. Distributors Everywhere.

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY



Putting Air to Work for RCA: Special machines for mass production each create 112,750 BTU's, cause special problems.



Ten Westinghouse fans exhaust the intense heat caused by flame jets and induction heating. This highly efficient Silentvane® fan does the job well, requires little maintenance.

Installed by Kirk & Blum Manufacturing Co., Cincinnati. Consulting Engineer: Paul P. Kopf, Philadelphia.

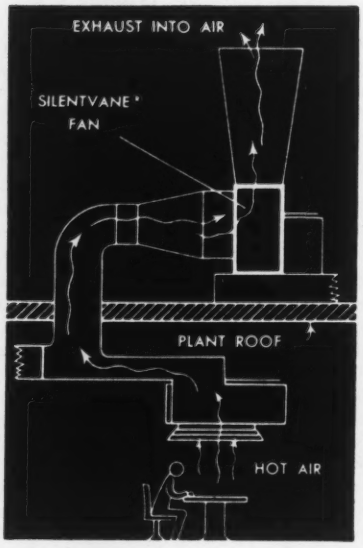
2,900,000 BTU EXHAUSTED

—OPERATORS STAY AT PEAK EFFICIENCY

Turning out miniature electron tubes is a hot business at RCA. Using a gas flame and induction heating, the process develops 2,931,200 BTU every hour. Exhausting this heat permits operators to work at peak efficiency.

Dependable Westinghouse fans handle the heat removal. They're rugged, can easily take the intense heat. And they do it quietly, efficiently.

If *you* have a heat exhausting requirement, or need ventilation for any purpose, let us help you. Westinghouse makes the most complete line of air handling, air conditioning and electronic air cleaning products available. Call your Westinghouse-Sturtevant office, or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.



WESTINGHOUSE AIR HANDLING

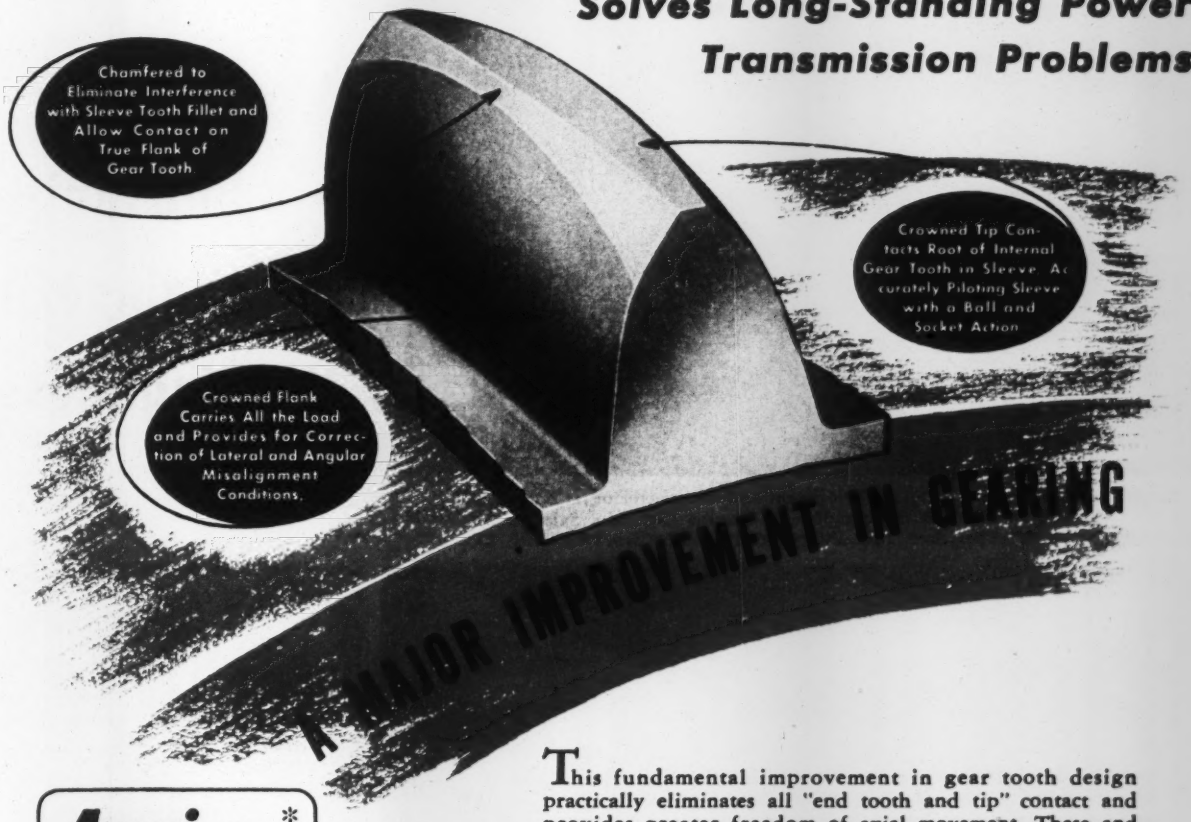
YOU CAN BE SURE ... IF IT'S **Westinghouse**

J-80297

THE Amerigear* FULLY CROWNED TOOTH DESIGN

*Trade Mark Reg.

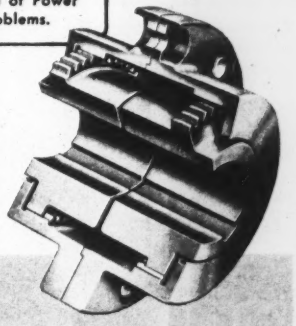
Solves Long-Standing Power Transmission Problems


Chamfered to Eliminate Interference with Sleeve Tooth Fillet and Allow Contact on True Flank of Gear Tooth
Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve. Accurately Piloting Sleeve with a Ball and Socket Action
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignment Conditions.
A MAJOR IMPROVEMENT IN GEARING

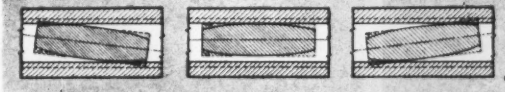
This fundamental improvement in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. These and other exclusive advantages of Amerigear Couplings distinguish them from common gear-type couplings. There are numerous instances where the fully crowned tooth design of Amerigear Couplings has been utilized to simplify power transmission mechanisms and add reliability to performance in a measure heretofore considered impossible.

Amerigear Couplings offer many more advantages than are obtainable with common basic designs. If your problem arises from excessive offset or angular misalignment, tight backlash requirement, space limitations, high speeds and loads, or any combination of these, it can be solved by the use of Amerigear Couplings. Amerigear Engineers are available for consultation.

Amerigear*
Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.



Oil Seals of Amerigear Couplings Are As Advanced in Design, Performance, and Effectiveness As Is the Amerigear Fully Crowned Tooth.



Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

AMERICAN FLEXIBLE COUPLING COMPANY

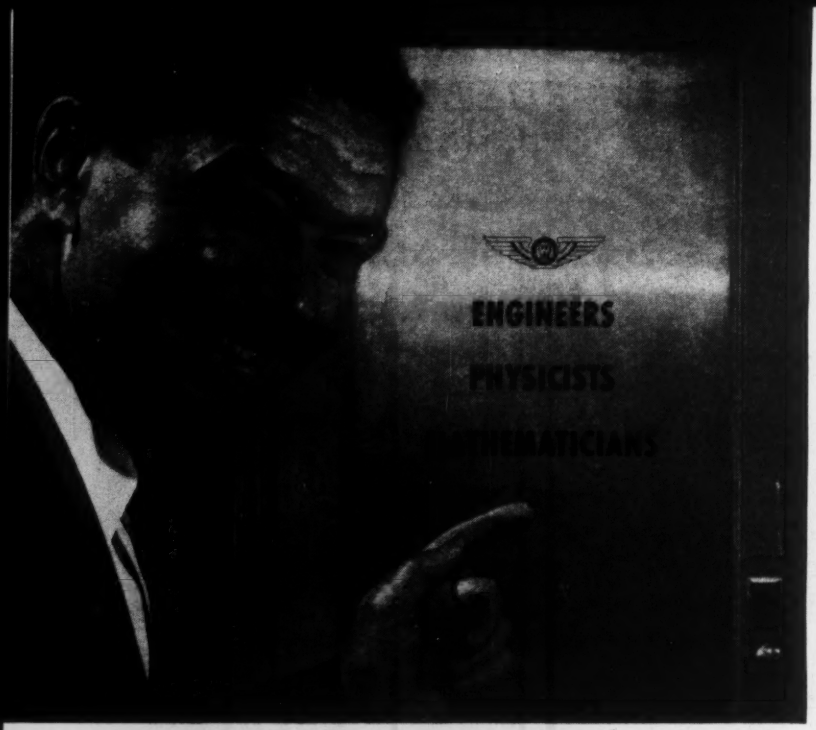
ERIE, PA., U. S. A. *Originator of the Amerigear Fully Crowned Tooth*

Sales Offices in Principal Industrial Centers

In Canada: Canadian Zurn Engineering, Ltd. • 2052 St. Catherine St. W., Montreal 25, P. Q. Canada

American Flexible Coupling Co., Erie, Pa., U. S. A.
Please send me further information regarding AMERIGEAR COUPLINGS with the Fully Crowned Teeth and Catalog No. 501.

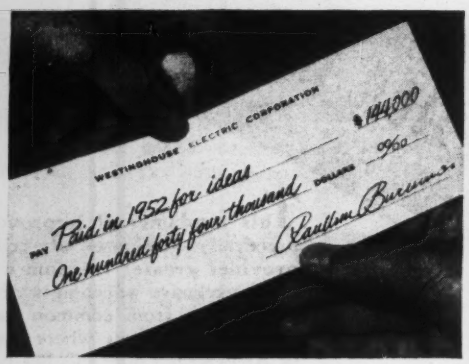
Name ..... *Title* .....
Company .....
Address .....
City ..... *State* .....
Please attach to your business letterhead.



Look at these new opportunities in jet engineering at Westinghouse

1. Immediate openings in research, development and manufacturing at our Aviation Gas Turbine Division in Philadelphia or Kansas City, Mo. Salaries are good, varying with experience and ability. You'll enjoy working with us.

2. Challenging work offers the opportunity of joining with Westinghouse, a long-time leader in jet engineering.

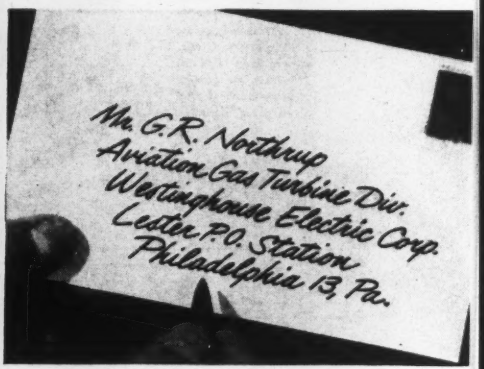


3. Incentive awards are given for inventions and ideas. Creative work is recognized and rewarded. We even pay your tuition for graduate study.

4. "Extras" include a modern pension plan; low-cost life, health, and accident insurance; company stock bonus.

5. Security we consider important. Promotion is from within. We're in this new, expanding industry to stay.

6. Living conditions in our suburbs are good with easy access to Philadelphia's many cultural and sports events. We will help you find housing.



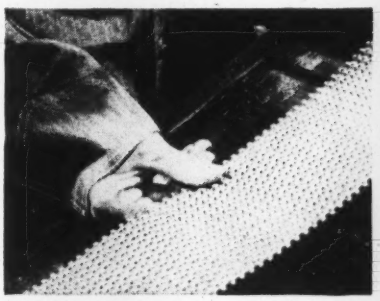
7. Write today to this address; send full details. We'll arrange for a confidential interview for all qualified applicants.

J-54023

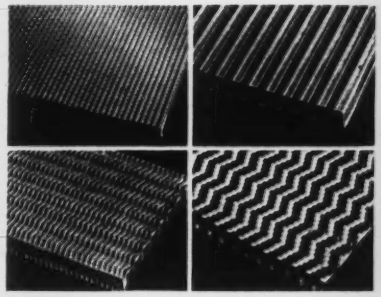
YOU CAN BE **SURE**... IF IT'S

Westinghouse

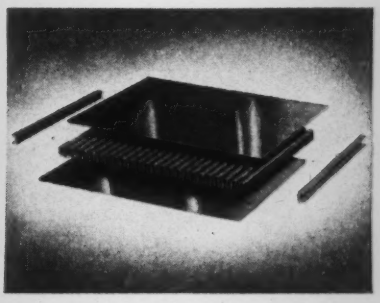
Here's how Trane brazes aluminum to solve tricky heat transfer problems...



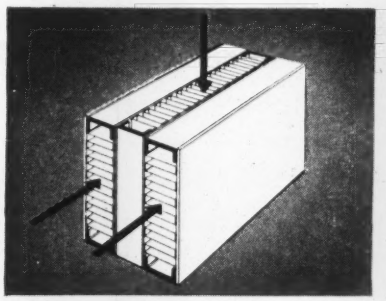
Corrugated fin surface for TRANE Brazed Aluminum Exchangers is formed in special presses from aluminum brazing sheet. Thickness can range from .005 to .032 inch; fin height to .50 inch; spacing 4 to 18 fins per inch.



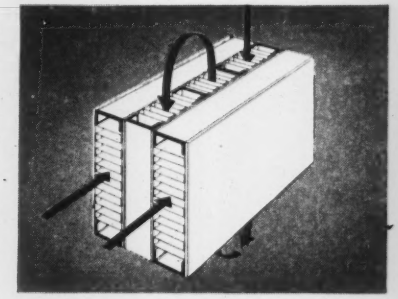
Many types of surface available. The brazed aluminum fins may be straight and continuous. Or they can be wavy, serrated or perforated to provide correct ratio of heat transfer to pressure drop.



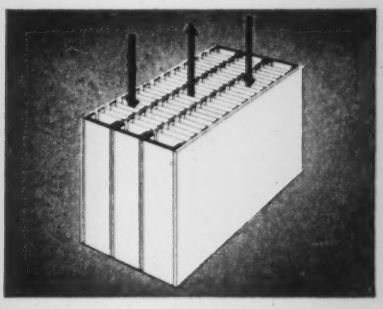
Exploded view shows component parts of a single passage. Fins, channels and parting sheets, all made from aluminum brazing sheet, become integrally bonded when assembled unit is submerged in a molten salt flux bath.



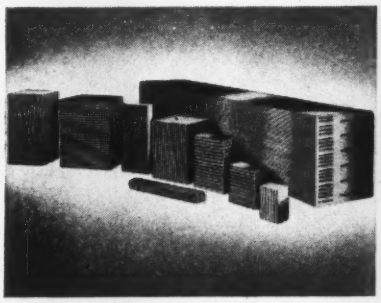
Cross-flow arrangement has fins in adjacent passages running crosswise to each other. TRANE Brazed Aluminum Surface can pack 450 square feet of heat transfer surface into one cubic foot of space.



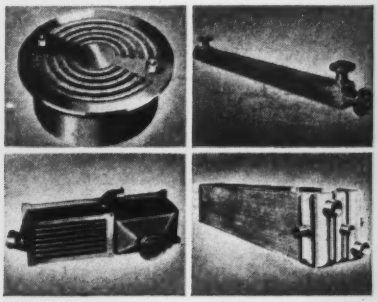
Multi-pass arrangement, like the cross-flow type, has fins in adjacent passages running crosswise to each other. With this arrangement, however, alternate passages are constructed to produce multiple passes.



Counter-flow arrangement has fins in adjacent passages running parallel to each other. A wide variety of different types of corrugated fin sheets can be used to handle different fluids in the same exchanger.



A wide range of core sizes is available up to 106 inches in length. Either bolt-on or integrally welded headers can be provided. Individual cores can be welded together to form larger multi-core units.



Design flexibility permits construction of units to handle practically any specification of heat transfer, pressure drop, volume, number and direction of passes. Some units handle as many as six different fluids simultaneously!

TRANE

pioneers in the science of heat exchange

If you have a tricky problem in heat transfer . . . TRANE Brazed Aluminum Exchangers may be the answer. Contact your TRANE Sales Office or write direct.

The Trane Company, La Crosse, Wis. • East. Mfg Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto. 80 U.S. and 14 Canadian Offices

AUTOMATION STARTS WITH WESTINGHOUSE MOTORS AND CONTROLS

How to keep a production line humming at peak capacity

You can't hear the steady hum, but if you could, you would say, "There's a well-built production line." The line just keeps on running, keeps on machining. It wasn't always that way, but it has been ever since Westinghouse Motors and Controls were installed back in 1950.

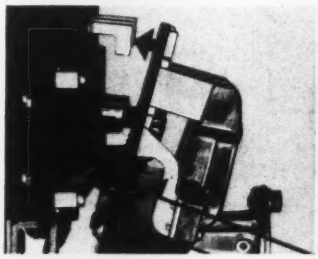
You see, when you standardize on Westinghouse Life-Line* Motors and Controls, you're installing the kind of horsepower that really increases output per man. For example, there's no down time for motor lubrication. Life-Line motors are pre-lubricated and sealed for life at the factory. Also, you don't need to worry about starters sticking. Life-Line Starters have an advanced clapper design that depends on a positive spring action instead of gravity. They can't stick or jam.

Trade Mark

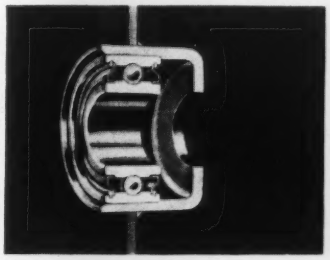
Remember, too, that Life-Line Starters give you permanent overload protection. A bimetallic snap-action, disc-type overload relay provides foolproof operation. It never loses its accurate factory calibration. And special insulation gives Life-Line motors maximum dielectric strength . . . enables them to resist moisture and mild chemicals.

Get these free moneysaving facts

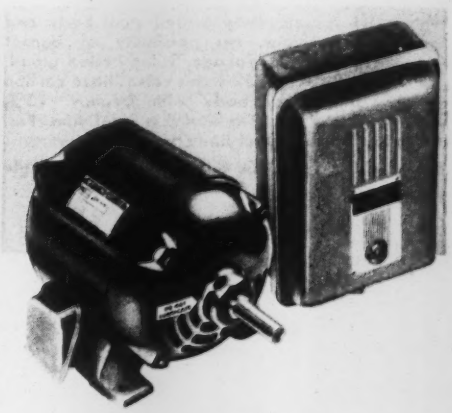
101 Life-Line Case Histories, B-4769, tells how 101 other manufacturers have used Life-Line motors to keep production humming at peak capacity. After you read how, see how from the movie, *Life-Line Speaks for Itself.* Phone your Westinghouse representative for this vital information, or write to: Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. J-21753



Here is a closing arrangement with fewer moving parts. The entire contact assembly pivots on a knife-edge of hardened steel. There are no sliding surfaces to bind or wear . . . no misalignment troubles. Jamming and sticking are eliminated. Nothing need be lubricated.



Westinghouse Pre-lubricated Bearings have the proper lubricant sealed in at the factory. Greasing schedules can be forgotten. Special seals guard against the entrance of harmful dust and dirt which ordinarily spell wear and possible bearing burnout.



YOU CAN BE SURE . . . IF IT'S

Westinghouse

Select Your Steel Valves

Edward GAGE VALVES 600 lb sp

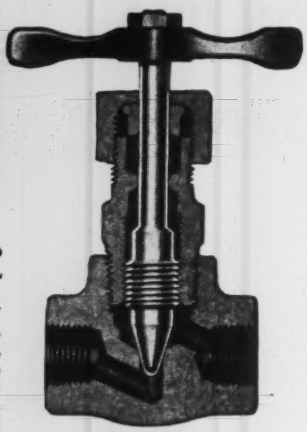


Fig. 152

FIG. 152 SERIES—A drop forged, instead of bar stock, steel valve for gage, meter, dead-end, instrument and other small lines, and for pumps, vents, Diesel and gas engines, etc. Long taper semi-needle type stem-disk for close regulation and tight seating. Fig. 152 series has carbon steel body with EValloy 13% chrome stem-disk. Fig. 2152 series, all 13% chromium stainless steel. Fig. 4152 series, all 18-8 stainless steel.

Screwed Ends—Globe or Angle

Size Range—⅛", ¼", ⅜", ½", ¾" and 1"

Edward INSTRUMENT VALVES 1500 lb sp

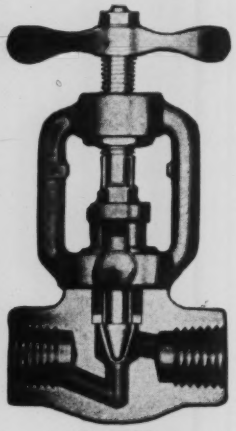


Fig. 952

FIG. 952 SERIES—A compact, heavy-duty valve for instrument panels, regulators, orifice meters, by-pass lines, oil field gage or instrument services, corrosive lines, etc. Drop forged steel body and yoke. No possibility of bonnet joint leakage. Swing bolted gland. Fig. 952 series valves have carbon steel body with EValloy 13% chromium stainless steel trim. Fig. 2952 series has EValloy stainless steel body and trim.

Screwed or Socket Welding Ends—O. S. & Y.—Globe or Angle

Size Range—¼", ⅜", ½"

Edward Globe & Angle Valves 600-1500 lb sp

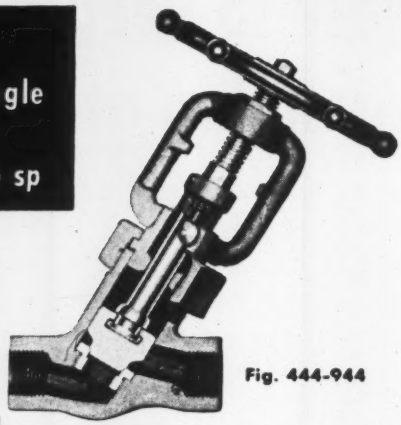


Fig. 444-944

FIG. 444-944 SERIES—All purpose valves, ideal for nearly any service where O. S. & Y. small forged steel valves are used. Streamlined, low-pressure loss body and bonnet both forged steel. Built with union bonnet in sizes 1" and smaller for 600 lb sp, and in sizes ¾" and smaller for 1500 lb sp. Larger sizes in both pressure classes have bolted bonnet joint. Bronze bushed yoke, simplified bolted gland design for easy packing adjustment, EValpak high pressure-high temperature die-molded packing, and inclined stem design for free flow and minimized turbulence are standard features. Easy to repack, with both hands free to insert packing. Stem, disk and seat hardened EValloy 13% chromium stainless steel regularly furnished; Stellite hard-faced seat and disk available on order.

Fig. 448-948

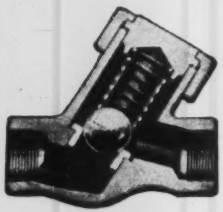
Screwed or Socket Welding Ends—O. S. & Y —Globe or Angle

Size Range—¼", ⅜", ½", ¾", 1", 1¼", 1½" and 2"

Edward CHECK VALVES 600-1500 lb sp

WIDE CHOICE

Edward forged steel check valves are built in ball or piston types, with union or bolted bonnets, with screwed, socket welding or flanged ends. Available for installation in either horizontal or vertical lines.

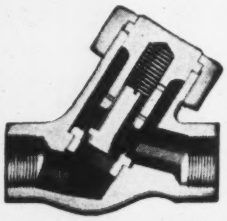


BALL CHECKS

Ideal for viscous fluid service. Spring loaded. fully guided ball disk is stainless steel, as is the mated seat.

Screwed or Socket Welding Ends—Horizontal or Vertical.

Size Range—¼", ⅜", ½", ¾", 1", 1¼", 1½" and 2".

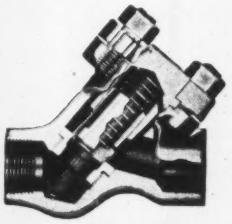


PISTON CHECKS

General service small check valves that give freedom from shock or excessive vibration, yet seat quickly and tightly upon flow reversal.

Screwed, Socket Welding or Flanged Ends—Horizontal or Vertical.

Size Range—¼", ⅜", ½", ¾", 1", 1¼", 1½" and 2".



BOLTED COVER CHECKS

Either ball or piston types, in variations of body style and end connections for boiler feedline or general process services.

Screwed, Socket Welding or Flanged Ends—Horizontal, Vertical or Angle.

Size Range—½", ¾", 1", 1¼", 1½" and 2".

From New Edward Designs

These are among the many new Edward designs. The Edward steel valve line is never static. From a development department devoting its time exclusively to the problems of temperature, pressure and other operating conditions usually associated with the use of steel valves, have come—through the years—literally hundreds of design and material innovations. Many Edward features have become industry standards; others are still exclusive with Edward. The new designs described briefly here are ideally suited for the service conditions of today's power plant, petroleum, industrial and technological installations.

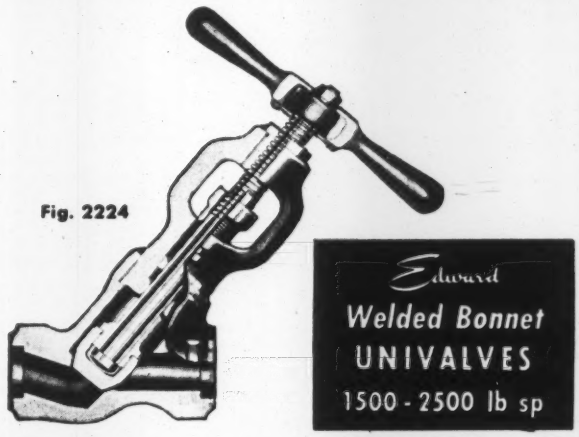
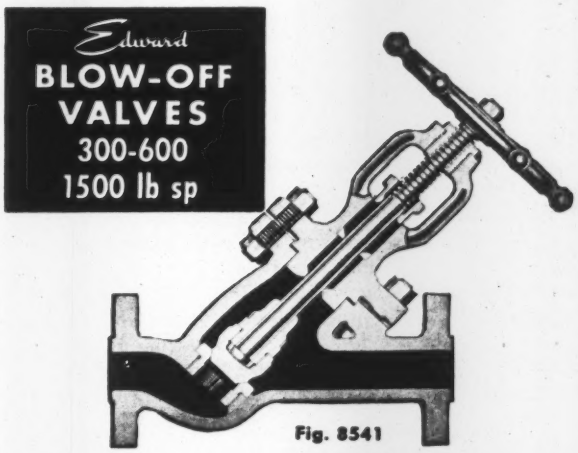


FIG. 2224 SERIES—Welded bonnet, inclined stem forged steel globe valves. Integral Stellited seat and disk construction, perfect alignment between body and bonnet, contoured for least resistance to flow and to cut wear-producing erosion. Bonnet joint leakage forever eliminated. Forged chromium-molybdenum bodies. Impactor handle available on larger sizes. Fig. 2224 series for 1500 lb service; Fig. 3924 for 2500 lb sp.

Socket Welding Ends—Globe Type

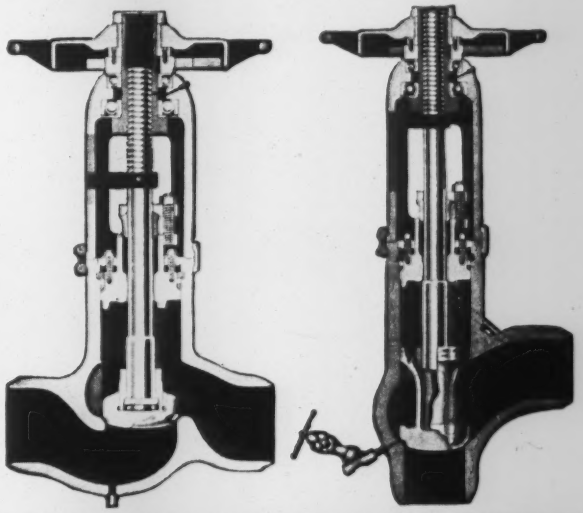
Size Range—½", ¾", 1¼", 1½" and 2"



FULL RANGE—Edward cast and forged steel blow-off valves, in straightway or angle patterns, meet all standards for blow-off valve service, and give complete flexibility in working piping hook-ups for any space limitation. Slow-opening type so that damaging shock to piping is eliminated.

Flanged or Socket Welding Ends — Straightway or Angle

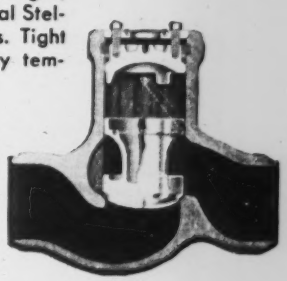
Size Range—1½", 2" and 2½".



Cast Steel Pressure-Seal Valves

900-1500-2500 lb sp

GLOBE AND ANGLE STOP, NON-RETURNS, CHECKS—Newest design pressure-seal bonnet valves in globe or angle stop or non-return and horizontal or angle check valves. Many features are Edward "firsts"—Impactor handwheels, EValthrust yoke bushings, Equalizers, streamlined flow passages, etc. Regularly built with integral Stellited seats and Stellited disks. Tight bonnet-joint connection at any temperature, low maintenance, easy disassembly, proven materials for top temperatures and reduced weight are among the features. All types in either 900, 1500 or 2500 lb sp classes.



Size Range—2½, 3", 4", 5", 6", 8", 10", 12" and 14".

For more data on these or other valves in the complete Edward steel valve line, write for Catalog 104. Or, if you indicate special interests in valves or various types, we can include special bulletins you will find helpful.

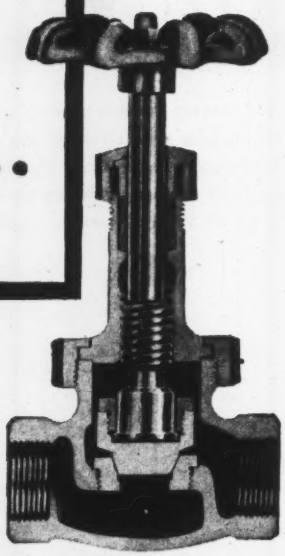
Another Product

Edward Valves, Inc.

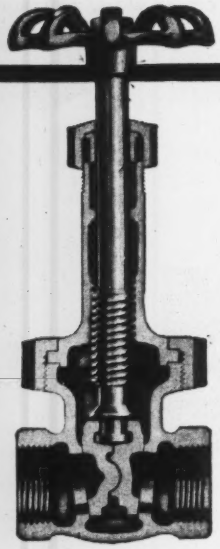
Subsidiary of ROCKWELL MANUFACTURING COMPANY

1350 W. 145th St., East Chicago, Indiana

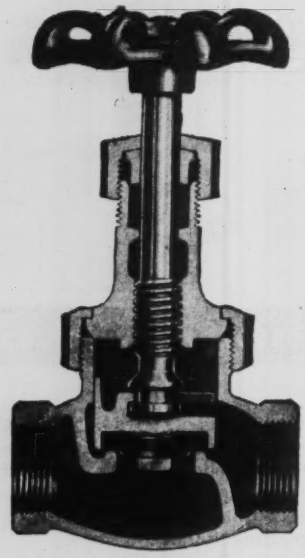
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:

GLOBE

GATE

ANGLE

WALWORTH
valves and fittings

60 EAST 42nd STREET - NEW YORK 17, N. Y.

CHECK

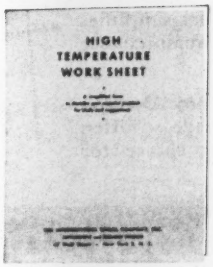
Which of these metals will

solve your High-Temperature problem?

Even the INCO Nickel Alloys may not provide a pat answer to that question, for strange reactions can take place when metals are exposed to high temperature corrosion.

When INCO's High Temperature Engineers do not have a known solution to your particular problem in all their amassed research information, they work with you to find it by testing the comparative durability of metals and alloys under your actual operating conditions.

First step is to write for this work sheet so that you can turn your problem over to INCO's High Temperature Engineering Service.



THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Please send me the High Temperature Work Sheet so that I may outline my problem to you.

Name _____

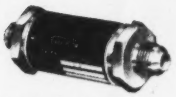
Address _____

City _____ State _____

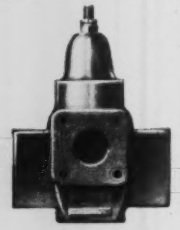
ME-9-53

BUILT TO TAKE IT

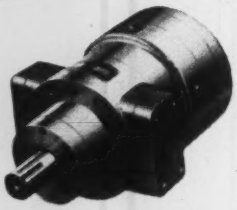
longer, with less maintenance, at pressures up to 5000 psi



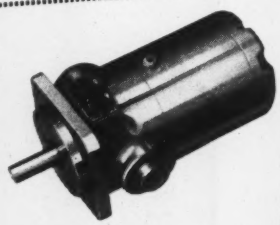
SURGE-DAMPING CONTROLS
Industrial and Aircraft Types
Eliminate Destructive Hydraulic Pressure Shock
¼" to 1" Sizes
For Pressures to 5000 psi
Catalog VS-1-A



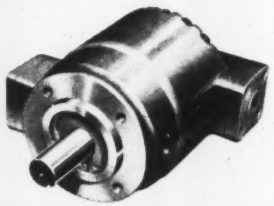
Direct-Operating PRESSURE CONTROLS
½" to 1½" Sizes
For Pressures to 2000 psi
Catalogs VRD-1 through VRD-8



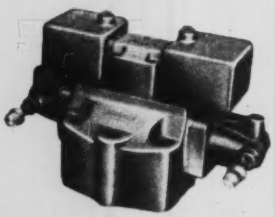
High-Pressure Axial-Piston PUMPS
Constant or Variable Volume
For 2500, 3000 and 5000 psi Circuit Needs
3.5 to 35 gpm Capacities
Catalogs P-4 through P-4-10



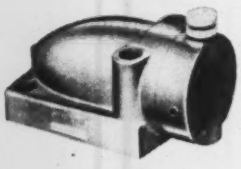
High-Torque Axial Piston FLUID MOTORS
Torque Ratings 13.8 to 112 inch-pounds per 100 psi (about 3 to 180 hp maximum)
For Pressures to 5000 psi
1500 to 3000 rpm
Catalogs FM-1, FM-2, FM-3-A



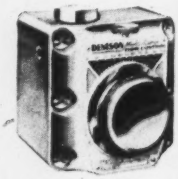
Dual-Purpose, Vane-Type PUMP/MOTOR
Ready for either pump or motor use without change
Shaft rotation in either direction
Four Sizes, 11 Models
Pumping Capacities: 3 to 82 gpm.
Motor Torque: 13 to 257 inch-pounds per 100 psi. Pressures to 2000 psi.
Bulletin P-5



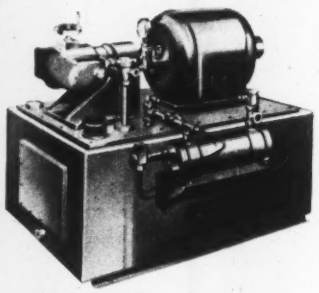
DIRECTIONAL CONTROLS
Manual, Mechanical, Electric or Pilot Control. ¼" to 2" Sizes
For Pressures to 5000 psi
Catalog VD-3



PRESSURE REDUCING VALVES
¾" to 1½" Sizes
20 gpm to 65 gpm Capacities
For Pressures to 5000 psi
Catalog VPR-1



Multi-Range FLOW CONTROLS
Full-Scale Regulation—Adjustable for Varying Input
¼" to ¾" Sizes
For Pressures to 3000 psi
Catalogs VFC-1, VFC-2



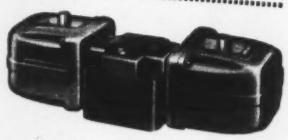
PUMPING UNITS
Constant and Variable Volume
46 Models—2 to 35 gpm Capacities
For Pressures to 5000 psi
Bulletins PU-3-A, PU-4 and PU-5

Denison HydrOILic PUMPS, MOTORS and CONTROLS

Proved in use—under many of Industry's toughest operating conditions—Denison HydrOILic Pumps, Motors and Controls are noted for their combination of high efficiency and rugged dependability.

In addition to fine performance under continuous, heavy-duty use, Denison HydrOILic Equipment offers space-saving design that simplifies circuit layout, makes installation easier, and minimizes maintenance problems.

Because so many users verify the extra value built into Denison Pumps, Motors and Controls, we continue the challenge made so often before—*let comparison prove to you* why they are first choice for so many needs of every type. Write today for full details on Denison HydrOILic Equipment to meet your requirements.



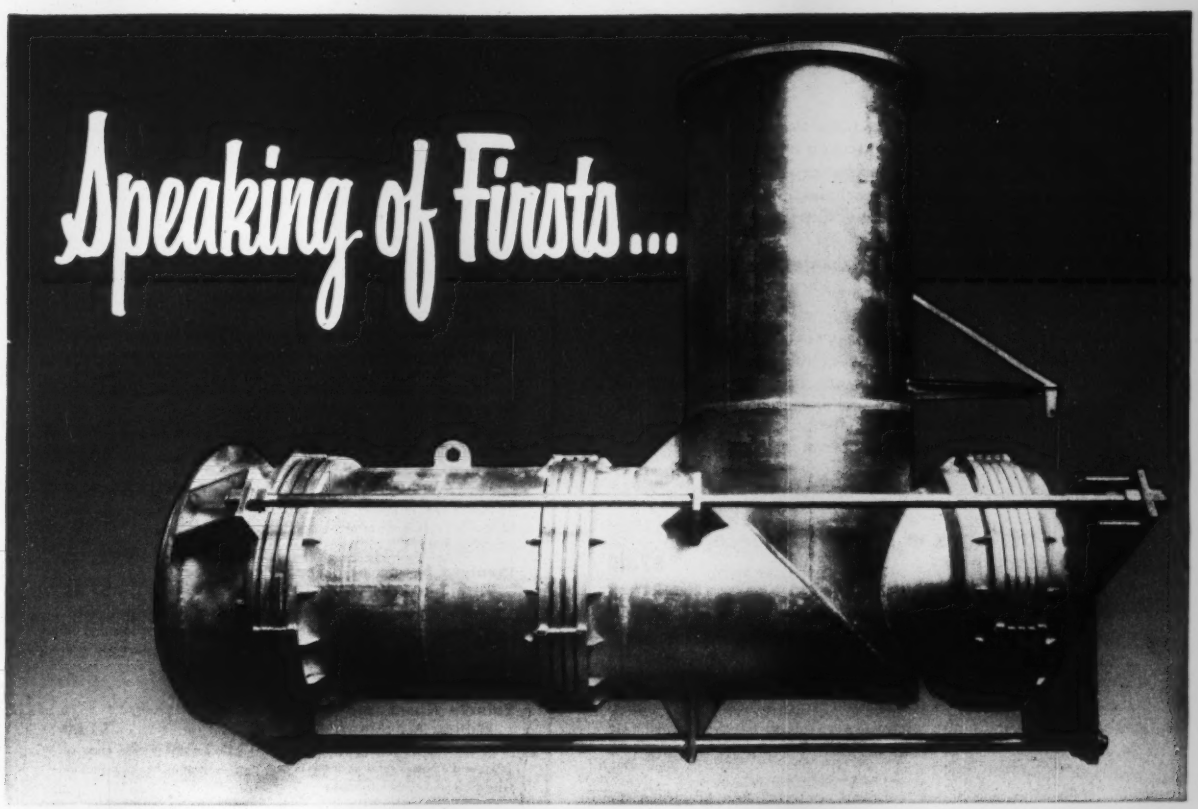
Pilot-Operated, Solenoid-Controlled DIRECTIONAL VALVES
Eliminate Spool-Sticking
¾" to 1½" Sizes, For Pressures to 5000 psi
Catalogs VD-1-1 to VD-4-2

Hydraulically Balanced PRESSURE CONTROLS
¾" to 2" Sizes
For Pressures to 5000 psi
Catalogs VR-2-B and VR-S-2

The DENISON Engineering Co.
1189 DUBLIN ROAD, COLUMBUS 16, OHIO

DENISON HydrOILics

"The Finest Money Can Buy!"



Recently, Zallea was given the assignment of developing a group of 48-inch expansion joints for flight propulsion test facilities on a classified defense project. The rigid technical specifications of this advanced application required "tailor-made" units for the job, so Zallea engineers analyzed the problem and designed the unusual-looking joint pictured above . . . the first of its kind. Actually, it is a Balanced Pressure, Universal Self-equalizing expansion joint, originally developed by Zallea engineers in 1945, operating at 165 psi and incorporating internal stainless steel turning vanes to provide a smooth flow of gases through the right angle bend. The unit absorbs 3" axial and 1.27" lateral movements through a temperature range from −100° F. to +650° F. No anchors are required since this arrangement neutralizes end thrust developed by internal pressures.

This example is representative of our ability to cope with the most difficult expansion joint problems. It is our business to specialize in the design and manufacture of one product only—expansion joints—and over the years we have learned how to solve the "tough ones" effectively and quickly.

Zallea Expansion Joints are available in diameters from 3 inches to 30 feet . . . for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs, and up to 2,000 psi in special designs.

The next time you are faced with an expansion problem, get in touch with us. We will be glad to survey your situation and recommend the most practical and economical solution. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 351.

Zallea
EXPANSION JOINTS

Design Data and Methods, *Applied Mechanics* **$4.00**

This 200-page book provides research workers and design engineers with a concentrated collection of information and data on strength of materials, fluid mechanics, lubrication, vibration and balancing. The compilation includes all of the material published in the 1944 edition and about 75 pages of new data.

Ten Years' Progress in Management, 1942–1952 **$1.50**

A trustworthy evaluation of a decade's development in such important areas of scientific management as statistical quality control, production planning and control, work simplification, wage incentives, industrial plant operation, purchasing marketing and distribution, personnel administration, public relations, labor relations, cost accounting, federal administrative management, and international co-operation.

This Report is the fifth decennial survey of progress to be published under the auspices of the ASME Management Division.

Glossary of Terms *in Nuclear Science and Technology* **$7.00**

Now, under one cover, precise definitions for over 2000 terms used in the fields of reactor theory, reactor engineering, chemistry, chemical engineering, biophysics and radiobiology, instrumentation, isotopes separation and metallurgy. The Glossary is divided into nine sections to enable the user to readily locate the terms peculiar to each of the aforementioned fields. An alphabetical arrangement of the terms has also been included to indicate the section or sections in which the definitions of the terms will be found.

Seventeen scientific and technical societies, ten governmental agencies, and four divisions of the National Research Council have co-operated in the preparation of this Glossary.

Lead-Base Babbitt Bearings, *A Symposium* **$1.00**

The four papers in this collection discuss lead-babbitt corrosion, the metallurgical factors of lead-base babbitt bearings, corrosion problems with high lead babbitt bearing alloys and, some effects of the application of lead-base babbitts to bearings.

Digital and Analog Computers *and Computing Methods* **$3.00**

This book summarizes the present state of high speed computation in the field of applied mechanics, exemplifies the way in which investigations of mechanical questions are being aided by machine computations at laboratories, and indicates the direction in which progress is being made.

How American Industry is Attacking *Materials Handling Problems* **75¢**

Shows how progressive companies are organizing for materials handling; describes the scope of the good materials handling program; considers the nature of the materials handling job, the characteristics of individuals in charge as well as the authority and responsibilities delegated to them; indicates the way in which these activities coordinate with, and contribute to, other aspects of the plant; and presents the techniques of anelyzing materials handling problems and the characteristics of basic materials handling devices.

NEW STANDARDS, CODES AND TECHNICAL BOOKS

Mechanical Power Transmission Apparatus, B15.1-1953 **$1.00**

This Code differs from the 1935 version in that it contains a number of modifications, clarifying statements, and new requirements. Rules cover all moving parts of equipment used in the mechanical transmission of power, including prime movers, intermediate equipment, and driven machines, excluding point of operation.

Safety Code for Private Residence Elevators, A17.1.5-1953 **$1.00**

Shows how to install a small electric passenger elevator or inclined lift in a private residence or in a multiple dwelling as means of access to a private residence in such a building.

Involute Spline and Serration Gages and Gaging, B5.21-1953 **$1.25**

Includes gage nomenclature, gage dimensions for splines, gagemaker's tolerances, gage wear allowances in relation to tolerances on the wear, the variation of the gage tolerances with the diameter and diametrical pitch of the wear, and gaging methods.

Spindle Noses and Arbors for Milling Machines, B5.18-1953 **$1.00**

Contains the essential dimensions of spindle noses, for ends of arbor and adapter, and of draw-in bolt end; also sketches of selective type of drive key construction.

Machine Tapers, B5.10-1953 **$1.00**

Presents basic dimensions of twenty-two sizes of self-holding tapers, detailed dimensions and tolerances for self-holding taper shanks and sockets, dimensions and tolerances for the plug and ring gages applying to this series of tapers, and the dimensions for twelve sizes of steep machine tapers.

Cast-Brass Solder-Joint Drainage Fittings, B16.23-1953 **$1.00**

These dimensions and tolerances are for fittings designed for drainage and vent systems using the solder-joint method of connection. Standard specifies sizes and method of designating openings for reducing fittings, marking, and materials; contains abbreviations for end connections and sketches and descriptions of the fittings.

Small Solid Rivets, B18.1-1953 **$1.00**

This Standard is a complete revision and consolidation of the documents covering small rivets, and tinners', coopers', and bel rivets published in 1927-28. Types of rivets for which dimensions, proportions, and tolerances are provided are designated respectively as flat head, countersunk head, button head, pan head, truss head, tinners', coopers', and belt rivets.

Letter Symbols for Meteorology, Y10.10-1953 **$1.00**

Sets forth general principles of letter symbol standardization, the approved symbols for 142 primary concepts, their dimensional characteristics in terms of mass, time, length and temperature, and the forty-four preferred symbols for secondary concepts.

Letter Symbols for Radio Y10-1953 **$1.00**

This new Standard contains an alphabetical list of symbols in order of quantity and another in order of symbol (Roman and Greek). In the former are 245 symbols and in the latter 172. General requirements for use of symbols and signs are outlined.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39 St., New York 18, N. Y.

How to Figure the cost of STEAM TRAPS

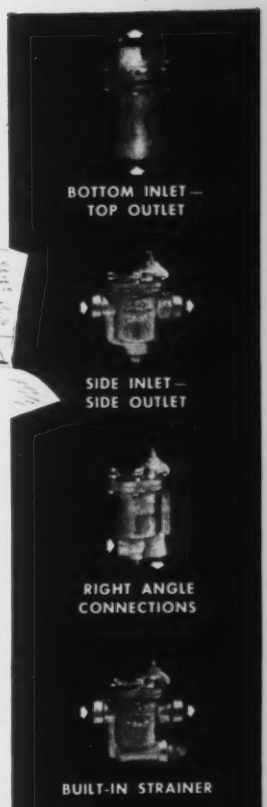
1. PRICE—you get a lot of trap for your money when you buy an Armstrong: big capacity in small size; the long-lasting mechanism in traps for low and medium pressures is identical in design, workmanship and materials, to that in traps for 900 degrees, 950 lbs. pressure!

2. INSTALLATION—Armstrong gives you a choice of body styles to save installation labor and pipe fittings.

3. MAINTENANCE—Armstrong traps last longer! You save labor, parts cost and downtime. Freedom from leakage saves fuel.

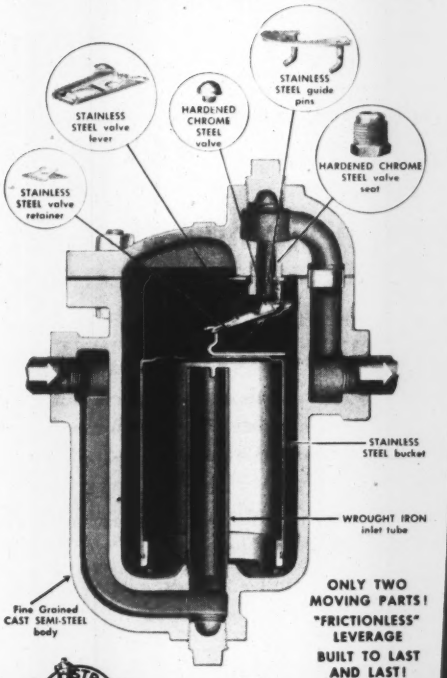
Divide total trap cost by the life of the trap to get *costs per year*—this is where Armstrong traps really shine. Call your Armstrong Representative for the traps you need now, or write:

ARMSTRONG MACHINE WORKS
894 Maple Street • Three Rivers, Michigan



Full Facts In
FREE Catalog J

Catalog J, also an educational handbook on condensate drainage, gives sizes, prices and capacities of Armstrong traps. It tells how to select traps; how to make hook-ups; how to trouble-shoot. Send for a copy today.


STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer
STAINLESS STEEL bucket
WROUGHT IRON inlet tube
Fine Grained CAST SEMI-STEEL body
ONLY TWO MOVING PARTS!
"FRICTIONLESS" LEVERAGE
BUILT TO LAST AND LAST!

STEAM TRAP CHECK LIST	ARMSTRONG TRAPS
Hardened chrome steel valve and seat?	Yes
All other parts stainless steel?	Yes
Long-lasting "frictionless" leverage?	Yes
Self-cleaning, non-clogging operation?	Yes
Choice of body styles?	Yes
Available with built-in strainers?	Yes
Available with internal check valves?	Yes
40 years inverted bucket trap experience?	Yes
Guaranteed *unconditionally* to satisfy?	Yes

ARMSTRONG STEAM TRAPS COST LESS!

Enter the Peerless

Win a fine camera in the Peerless Photocopy-in-Industry contest.
Contest lasts for three months. Complete set of prizes awarded each month.

1st PRIZE Contessa 35 Tessar f/2.8 . . retail price $216.00
(choice) Ikoflex IIa Tessar f/3.5 . . . retail price $216.00

2nd PRIZE Contina I 35 Tessar f/2.8 . retail price $119.00
(choice) Ikoflex Ia Novar f/3.5 . . . . retail price $125.00

3rd PRIZE Nettar IIc Novar f/6.3 . . . . retail price $ 41.70

The cameras listed above will be sent to the winners of this contest at absolutely no cost. All cameras come complete with top-grain leather carrying cases. All carrying charges prepaid.

The contest is open to everyone actively interested in industrial photocopy.

HERE'S HOW YOU CAN WIN

Write a report on one of the photocopy applications or photocopy techniques that you find most valuable in your business. There is no limit to the length of your report. It can be supplemented with examples of the result achieved, sketches of the process, anything which you feel will lead to a full appreciation of your use of photocopy. Although originality is important, the significance of the result achieved will determine the winners.

Example: Suppose you use photocopy to eliminate certain drafting steps such as the redrawing of an entire part in order to make a simple change. Tell in your report exactly what steps you take to get the desired result. Tell also what this means to your drafting department in terms of time saved. Name the paper and machines involved in your process, and tell why you use them. Remember, the more complete and understandable your report, the better your chances are of winning.

CONTEST CLOSING DATES

To qualify for the 1st month's awards, entries must be postmarked no later than October 10, 1953. Winners will be notified by mail as soon as each month's judging is completed.

To qualify for the 2nd month's awards, entries must be postmarked no later than November 10, 1953.

To qualify for the 3rd month's awards, entries must be postmarked no later than December 10, 1953.

THE JUDGES

The contest will be judged by the executive board of Industrial Photography magazine: Ben Zale, Editor; Lloyd E. Varden, Scientific-Technical Editor; David B. Eisendrath, Jr., Technical Editor. All contest entries will be sent to this board for judging, and the winners reported after each monthly closing date.

Photocopy Contest

1st Prize—Ikoflex IIa
A truly fine reflex camera with Zeiss Opton coated Tessar f/3.5 lens, in Synchro Compur fully synchronized shutter. Speeds from 1 to 1/500 sec.

1st Prize Contessa 35
An outstanding 35 mm camera with 45 mm Zeiss Opton coated Tessar f/2.8 lens. Automatically focused by a built-in combined view and range-finder. Has built-in photo-electric exposure meter. Synchro Compur shutter is fully synchronized. Speeds from 1 to 1/500 sec.

2nd Prize Ikoflex Ia
Easily the finest reflex camera in its price class. Has Novar f/3.5 coated lens in a fully synchronized Prontor SV shutter with speeds from 1 to 1/300 sec.

2nd Prize Contina I 35
A superior 35 mm camera with Zeiss Opton coated Tessar f/2.8 lens, with optical range finder. Has fully synchronized Synchro Compur shutter. Speeds from 1 to 1/500 sec.

3rd Prize Nettar IIc
An excellent camera with extremely rigid construction. Comes with a Novar f/6.3 coated lens in Vario shutter. Flash synchronization at 1/25 sec.

THE ZEISS IKON CAMERA

Based on 90 years' tradition of fine camera manufacture, Zeiss Ikon cameras are recognized as symbols of photographic excellence throughout the world. Whether you are professionally interested, an amateur enthusiast or a snap-shot photographer, a fine Zeiss Ikon camera will give you a lifetime of photographic pleasure. For those of you who have never taken many photographs, there is no better introduction to its enjoyments than a truly superior Zeiss Ikon product.

All Zeiss Ikon cameras are made in the U. S. Zone, Stuttgart, Western Germany.

All prices shown are national retail list prices, federal tax included, from the latest Zeiss Ikon price list published August 15, 1953.

YOUR REPORT IS A VALUABLE CONTRIBUTION TO THE INDUSTRY

We are planning to publish the winning reports as a portfolio of modern photocopy practices. The purpose of this portfolio will be to show how valuable photocopy is as an industrial tool, and as evidence of what is being done by experts in the field. No report will be published in the portfolio, or used in any other advertising or promotional material without your written permission and that of the company involved.

CONTEST RULES

1. Write a report on what you feel is an important use of photocopy in your company. You can send in as many reports as you want; however, you can win only once. If you have more than one report to submit, your best chance of winning a major prize is to space your entries in different contest months.

2. Be sure to include your name, position and company name and address on the report.

3. If you are a winner, you will be notified by mail. For 1st or 2nd prize winners you have your choice of the cameras listed; sent either to your home or office.

4. Please pay particular attention to the contest closing dates. No entry can be judged which is postmarked later than December 10, 1953.

5. All entries become the property of Peerless Photo Products, Inc. The decision of the judges is final.

6. The contest is open to everyone actively interested in industrial photocopy with the exception of employees and distributors of Peerless Photo Products, Inc.

PEERLESS PRODUCTS

Peerless is one major manufacturer in the field whose production and development facilities are devoted exclusively to industrial, scientific and commercial photo-reproduction. The entire Peerless line of photocopy papers and machines is sold only through a network of factory distributors who are skilled photocopy specialists. Complete literature on all Peerless products is yours for the asking.

DON'T DELAY!

Send your report to:

PEERLESS PHOTO PRODUCTS, INC.

Shoreham, Long Island, N. Y.

Manufacturers of quality Photocopy Papers and special-purpose Industrial Photocopy Equipment

Where INSUL-MASTIC stands guard!

Moist, salty atmosphere makes the Gulf Coast of Texas the *Playground of Corrosion.* Here Refineries and Chemical Plants rely upon Insul-Mastic Coatings for protection against rust. From Brownsville to Lake Charles you will find tanks, towers, pipes, vessels and other equipment heavily sprayed with this *Superior* coating. Maintenance operations everywhere have been greatly reduced because INSUL-MASTIC's protection will last for many, many years.

Stopping moisture alone does not prevent corrosion here. Acid, alkali and other industrial vapors work hard to break down coatings and get at the metal beneath. That's why the very durable INSUL-MASTIC coatings are so extensively specified along the Gulf Coast. They are extremely resistant to chemicals as well as to moisture.

INSUL-MASTIC's record in *corrosion's playground* cannot be approached. There are many years and hundreds of jobs to prove its lasting protection. Specify INSUL-MASTIC to prevent corrosion.

Insul-Mastic's record also includes vaporsealing thermal insulation. There's no better way to keep your insulation dry.

Think First of the Coatings that Last!

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CORPORATION OF AMERICA
Oliver Building • Pittsburgh 22, Pa.
Representatives in Principal Cities

Coming up...

22,000 malts every hour

Link-Belt-engineered power transmission provides high efficiency for malt production

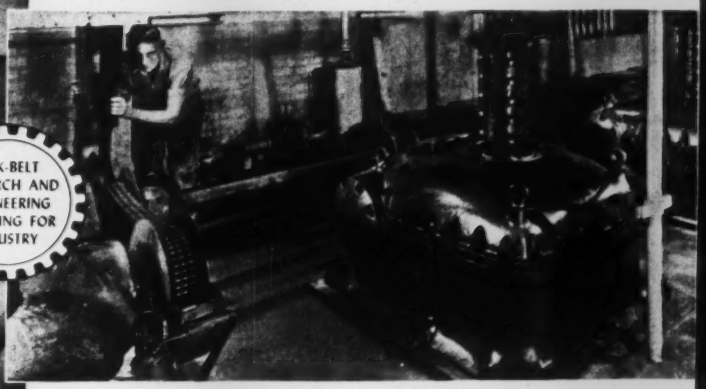
THE malt that brings a gleam to the eyes of the nation's youngsters . . . the container it is mixed in . . . the counters at which they sit—all these familiar things and many others are produced with the help of Link-Belt equipment. In fact, almost every American every day is touched in some way by the engineering and mass production facilities of Link-Belt.

Yes, in practically any industry you can name, you'll find striking evidence of Link-Belt ingenuity at work in hundreds of conveying, processing and power transmission applications. From the start of the raw materials to the finished product, the equipment of this company moves the material and transmits the power. For full information call the nearby Link-Belt office. An experienced engineer will be glad to work with you.

LINK-BELT

One source . . . one responsibility for materials handling and power transmission machinery

LINK-BELT COMPANY, Executive Offices: 307 N. Michigan Ave., Chicago 1. Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices, Factory Branch Stores and Distributors in Principal Cities. 13 336



Drying operation in Borden's malted milk factory at a rate of 600 pounds per hour demands accurate, positive power transmission. This integrated installation includes Link-Belt worm gear speed reducers, roller and silent chain drives, flexible couplings, roller bearings and shafting. Stocks of these and other Link-Belt products are immediately available from your nearby Link-Belt factory branch store or distributor.

The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.

TF

For up-to-the-minute facts, see your Taylor Forge distributor

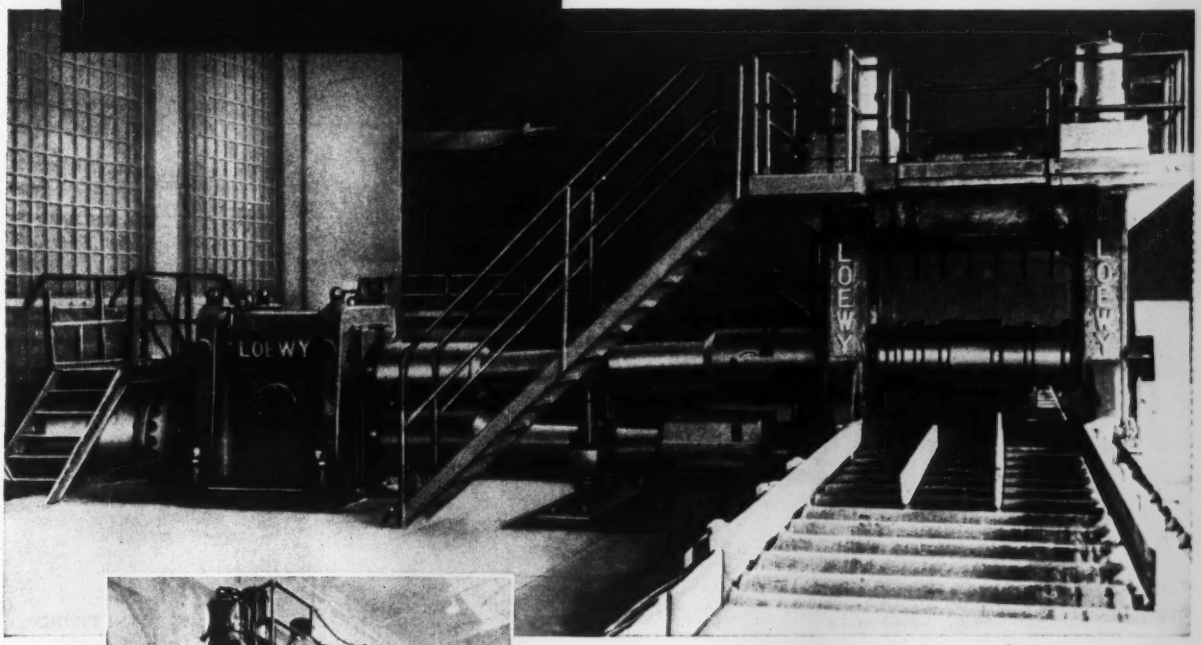
TAYLOR FORGE

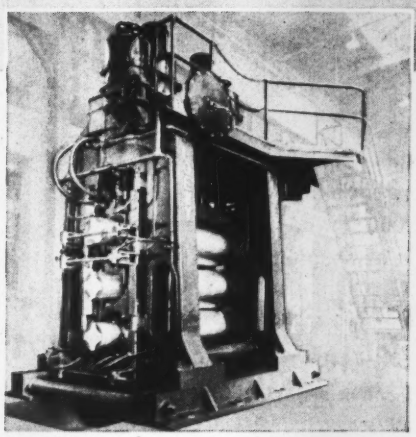
TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

WE BUILD COMPLETE ROLLING MILL INSTALLATIONS

- Hot and cold Rolling Mills for ferrous and non-ferrous metals and auxiliary machinery such as Shears, Levellers, Straighteners, Coilers, etc.
- Extrusion plants for steel and non-ferrous metals
- Forging and Die Forging Plants
- Deep drawing single and double acting Presses
- Die Casting Machines for Aluminum and Brass

Below:
26" Two-high Blooming Mill, part of a complete Blooming, Slabbing, Structural and Strip Mill Installation.





Left:
26" Three-high Blooming Mill Stand, part of a complete Blooming, Slabbing, Structural, Wire Rod and Strip Mill.

LOEWY-HYDROPRESS ROLLING MILL DIVISION

HYDROPRESS INC

ENGINEERS • CONTRACTORS

Rolling Mills • Hydraulic Presses • Pipe Testing Machines • Special Pipe Mill Equipment • Accumulators • Pumps • Die Casting Machines

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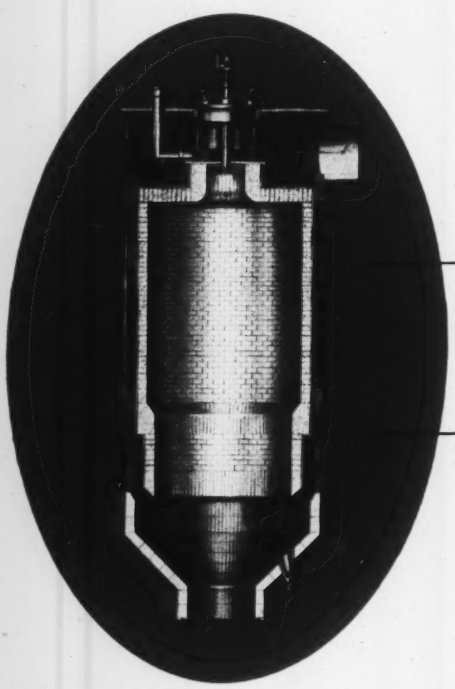
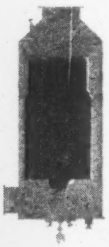
higher **loadings** (BTU/FT.^{3})

with **PEABODY**

CYLINDRICAL FURNACES

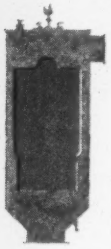
for compact, efficient combustion





UP FIRING

HORIZONTAL FIRING



DOWN FIRING

Typical Applications:
Spray Driers
Rotary Driers
Catalyst Regenerators
Liquid Concentrators
Inert Gas Generators
Tunnel Driers
Stack Heaters
Calciners
Petroleum Refineries
Special Processes

Compact and flexible, Peabody cylindrical furnaces are available for applications requiring hot gases — at temperatures up to 3000°F and pressures from below atmospheric to over ten atmospheres.

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Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers

Peabody's 33 years of experience can be placed at your disposal for any industrial or chemical process problem requiring hot combustion gases at closely controlled temperature levels.

PEABODY LIMITED • LONDON, S.W. 1, ENGLAND

536

Here are 3 good ideas for you

Consider them in the light of helpful suggestions—each representing an advantage in a distinctive type of tube fabrication that could mean:

A DECREASE IN PRODUCTION COSTS

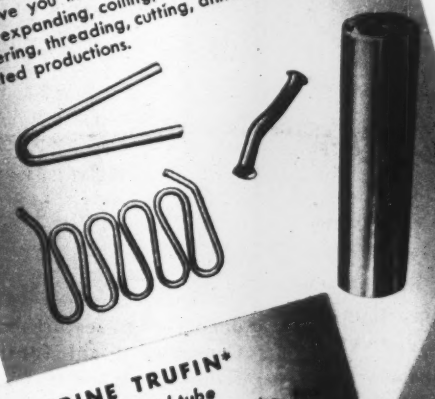
A REDUCTION IN MAINTENANCE COSTS

AN IMPROVEMENT IN YOUR PRODUCT

AN INCREASE IN OPERATING EFFICIENCY

FABRICATED TUBULAR PARTS

Many tubular parts, surprisingly enough, can often be produced more economically by using an existing tubular form to begin with and carrying on from that point. Wolverine facilities are ready to serve you in these operations: bending, spinning, expanding, coiling, finning, beading, flaring, soldering, threading, cutting, annealing, and other related productions.



PARTS MADE BY OUR SPUN END PROCESS†

Countless numbers of tubular parts can be produced better and more economically by the Spun End Process than can be done in any other way. This process—an exclusive Wolverine development—can provide an almost unlimited variety of tubular shapes; suggest more attractive and more practical design; decrease or even eliminate assemblies.

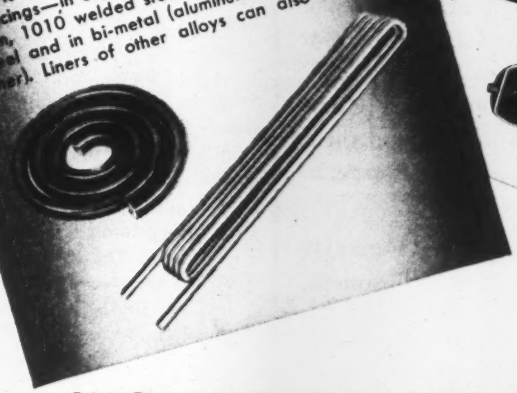
Our Spun End Tube Brochure has much helpful information for you. Would you like a copy?

WOLVERINE TRUFIN*

—The integral finned tube

Because of its one-piece construction—the fins being extruded from the tube wall itself—Trufin presents many advantages for you. It will withstand vibration and sudden temperature changes—an important feature in heat transfer applications.

It is available in a wide range of sizes and fin spacings—in copper, copper base alloys, aluminum, 1010 welded steel and type 304 stainless steel and in bi-metal (aluminum fins and copper liner). Liners of other alloys can also be used.



*REG. U.S. PAT. OFF.

†A PATENTED PROCESS RE. 22463

WOLVERINE TUBE DIVISION

of CALUMET & HECLA, INC.

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Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

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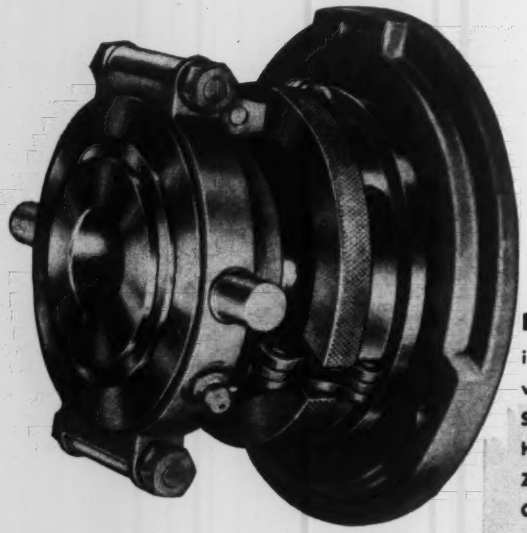
Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ont.

Check JOHNSON single disc a Better CLUTCH for the same money



Better

BECAUSE . . . it's the only clutch with SEPARATOR SPRINGS that prevent heating in both HORIZONTAL and VERTICAL installations.

For some time there has been a demand for a single disc clutch for positive control of power transmission in the field of light machinery . . . a clutch that would stay cool on the job in both horizontal and vertical installations. This is "it."

If extreme compactness is not an essential, the Johnson No. 350 (3 h.p. max.) and No. 450 (6 h.p. max.) will meet or beat competition . . . as a better clutch at a competitive price. They incorporate most of the design principles of our Maxitorq multiple disc . . . and except for compactness and capacity, you will find them tops in their field. (Please read column at right . . . "Frankly Speaking" . . . for use recommendations.)

Several driving combinations are available, including V-belt. A simple hex key frees the knurled ring for easy manual adjustment. The "floating" disc prevents drag, abrasion, and heating in neutral. Machine and product designers will solve many problems in the light machinery field with this new Johnson single disc Clutch.

Send for Bulletin No. 250-ME-9

THE CARLYLE JOHNSON MACHINE CO.
MANCHESTER . . . . . CONNECTICUT

6CJ83

Frankly SPEAKING

Because of a large backlog of orders, The Carlyle Johnson Machine Company found it necessary to postpone the announcement of the new Johnson Single Disc Clutches.

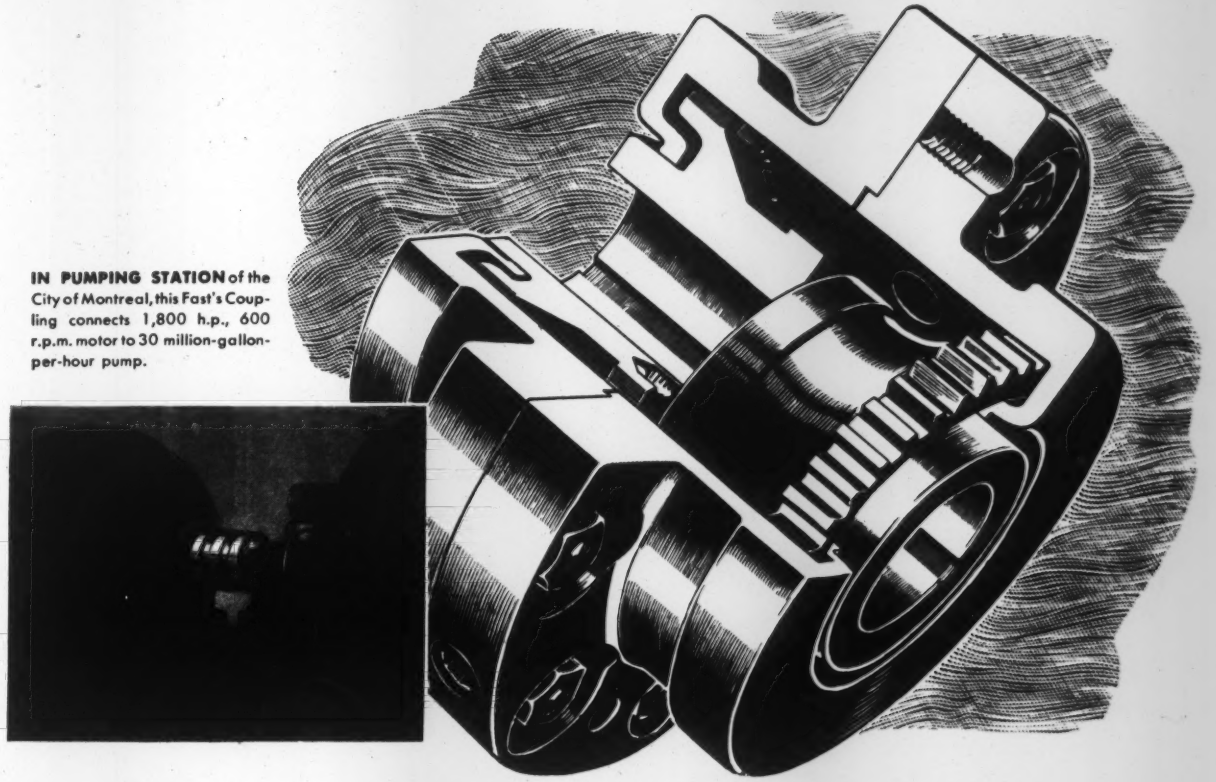
Now, with added equipment for high speed production, it is possible to produce and ship the new clutches without undue delay. In fact, small orders or units for try-out in new machines will be forwarded at once. Design features make the Johnson especially suitable for installation in the following machinery:

Accessory Drives, Air Compressors, Bag Making, Boat Drives, Bread Wrapping, Chain Drives, Combines (farm), Conveyors, Crop Seeders, Cultivators, Dusting Machines, Feed Grinders, Floor Scrubbing, Fruit Cleaners, Gasoline Engines, Generator Drives, Hay Balers, Hoists, Loaders, Lawn Mowers, Milk Coolers, Mixing Machines, Motor Scooters, Packaging Machines, Paper Shredders, Power Fans, Power Saws, Power Take-offs, Pumping Equipment, Sand Spreaders, Sewing Machines, Sheep Shearers, Spraying Equipment, Textile Machinery, Threshers (small), Tobacco Machinery, Tool Grinders, Tractors (garden), V-Belt Drives, Vegetable Sorters.

Naturally, these are but a few of the possible applications for the Johnson Single Disc Clutch. The field is wide open, with new machinery constantly being developed.

Included in the driving combinations are: Gear Tooth, Bolted Plate, Pulley Type, Hub Adapter, Cut-off Coupling Adapter, Single V-Belt Pulley Drive, and Double V-Belt Pulley Drive.

Carlyle Johnson engineers offer their engineering assistance in cooperation with your engineers and machine designers to develop the correct solution of your power transmission requirements. Write to Frank R. Simon, The Carlyle Johnson Machine Co., Manchester, Conn.



IN PUMPING STATION of the City of Montreal, this Fast's Coupling connects 1,800 h.p., 600 r.p.m. motor to 30 million-gallon-per-hour pump.

For free engineering service that saves dollars and down-time . . .

FAST'S Couplings are FIRST!

When you specify Fast's Couplings, you get the benefit of Koppers *free engineering service* . . . your assurance of the right coupling for any job and the right solutions to tough coupling problems.

FOR EXAMPLE: "Get the drawings and send them down to Koppers" is the standard answer in one plant whenever a tough coupling application arises!

FOR EXAMPLE: After studying a list of spares for stand-by units made up by one customer, a Koppers sales engineer eliminated duplications . . . resulting in a smaller order for him but a *much smaller inventory* for the customer!

Add the *rugged construction* of Fast's Couplings . . . with their original design maintained without basic change or sacrifice in size or materials. Add their lowest cost per year . . . their life expectancy guarantee. *Fast's usually outlast the equipment they connect.* Result: it will pay you to write today for full details on how Fast's Couplings and Koppers Engineering Service can help you get uninterrupted power transmission! Send for free catalog to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 259 Scott Street, Baltimore 3, Md.

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Engineered* Products Sold with *Service

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Gentlemen: Send me a Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

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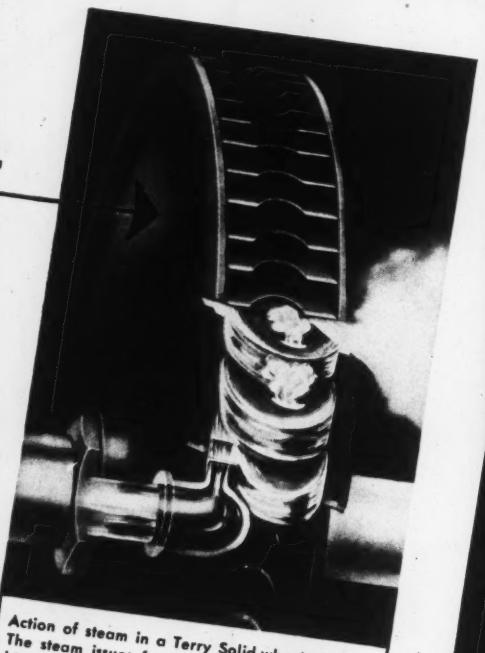
TERRY

THIS TURBINE WHEEL

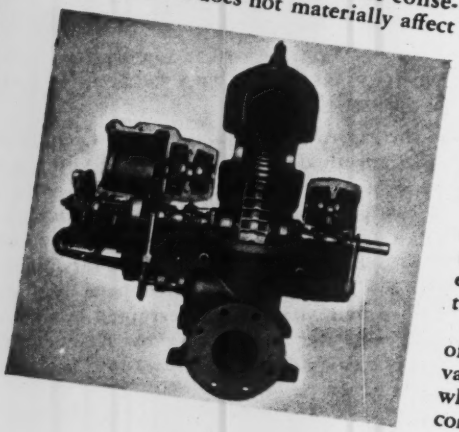
has no parts to loosen or work out

The rotor of the Terry Solid-wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

The power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Hence, wear of the blades is of little consequence, as it does not materially affect horsepower or efficiency. There is practically no end thrust since the steam enters and leaves the wheel in a direction at right angles to shaft.



Action of steam in a Terry Solid-wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.



This is only a small part of the story of the many advantages of the Terry Solid-wheel Turbine. Write for complete details.

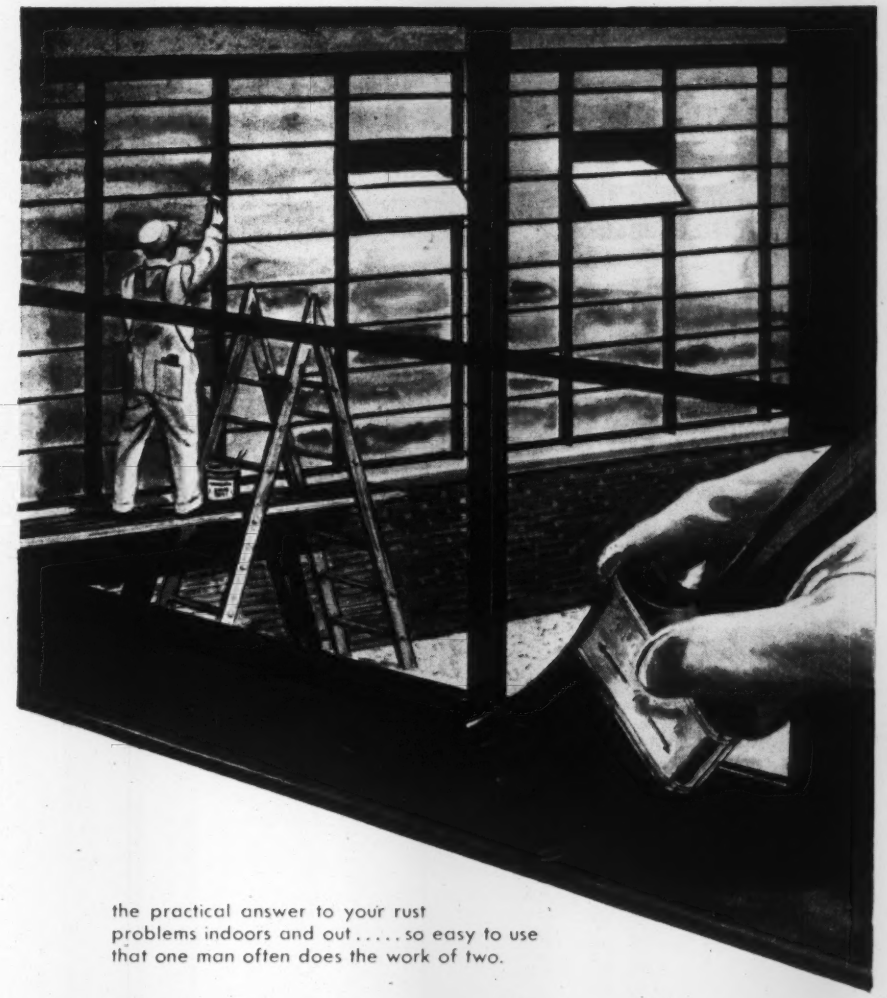
THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TT-1189

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.



the practical answer to your rust problems indoors and out . . . . . so easy to use that one man often does the work of two.

RUST-OLEUM®

STOPS RUST!

Resists Rain, Snow, Heat, Fumes, Weathering, Salt Water, etc.

Rust-Oleum *cuts costly manhours!* Just scrape and wirebrush to remove rust scale and loose rust . . . . then brush Rust-Oleum 769 Damp-Proof Red Primer *directly over the sound rusted surface.* Rust-Oleum finish coatings available in many colors, aluminum, and white give you *double protection.* Sandblasting and other costly preparations are *not* usually required. Specify Rust-Oleum . . . prompt delivery from Industrial Distributor stocks in principal cities.

RUST-OLEUM CORPORATION
2900 Oakton Street, Evanston, Illinois

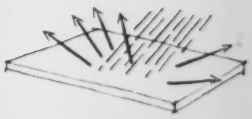
FREE SURVEY: Ask a Rust-Oleum specialist to conduct a survey including actual applications, tests, and recommendations. No cost or obligation. See Sweets for nearest Rust-Oleum distributor or write for literature today.

FACTS

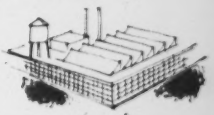
prove the economy of Rust-Oleum

Apply Directly Over Sound Rusted Surfaces—Brush Rust-Oleum 769 Damp-Proof Red Primer *directly* over *sound rusted surface* after scraping and wirebrushing to remove rust scale and loose rust. Sand-blasting, chemical pre-cleaning and other costly preparation methods are *not* usually required.

Available In Many Colors, Aluminum, and White, Brush, Dip, or Spray—Get *double protection.* Beautify as you protect with Rust-Oleum finish coats in the color of your choice.

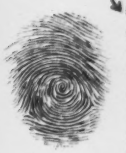


Practical, Economical Answer To Your Rust Problem—Rust-Oleum resists rain, heat, fumes, sun, salt air, salt spray, and many chemicals—as well as condensation indoors.



Proved Throughout Industry For Over 25 Years—On tanks, girders, pipes, machinery, roofs, buildings, fences, stacks, throughout industry — Rust-Oleum has *proved* its capacity to stop rust for over *25 years.*

There is Only One Rust-Oleum



Distinctive as your fingerprint, Rust-Oleum is an *exclusive formula* developed by a Master Mariner during more than 20 years battling actual rust conditions at sea. It incorporates a *specially-processed* fish oil vehicle that will *dry,* is odor-free, and is formulated in *many colors.* Be sure you specify genuine Rust-Oleum to assure satisfaction. Accept no substitute.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

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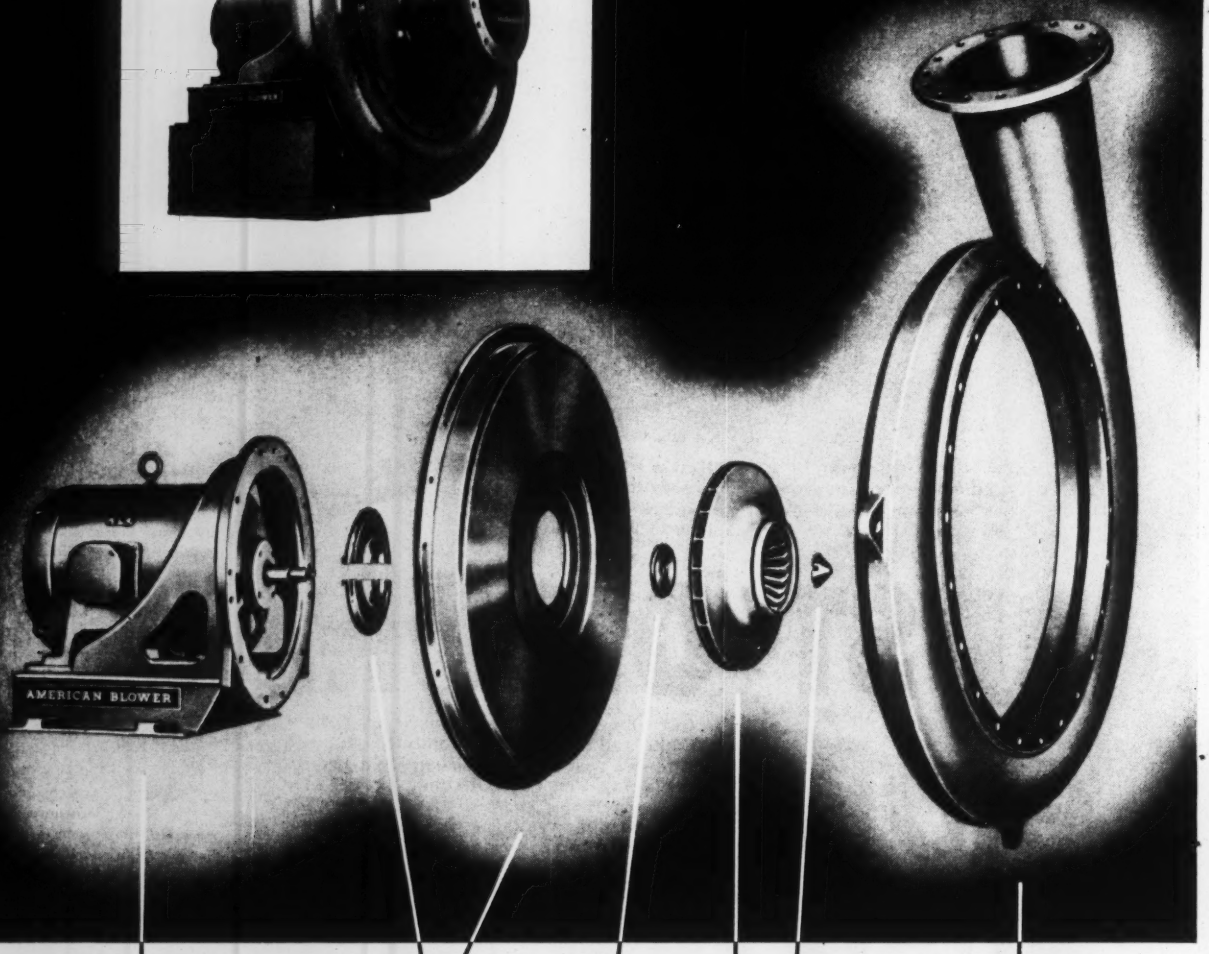
2900 Oakton St., Evanston, Illinois

- ☐ Have a Qualified Representative Call
- ☐ Free Survey
- ☐ Complete Literature
- ☐ Nearest Source of Supply

AMERICAN BLOWER

centrifugal



Motor — Standard NEMA construction. Short motor shaft extension and conservative impeller loads assure operation below first critical speed of rotor assembly. **Baseplate** — heavy welded steel for rigidity and accurate alignment.

Shaft Packing — Nonferrous, cast construction. No mechanical contact between stationary and rotating parts. **Backplate** — cast iron, bolts with dowel fit to baseplate.

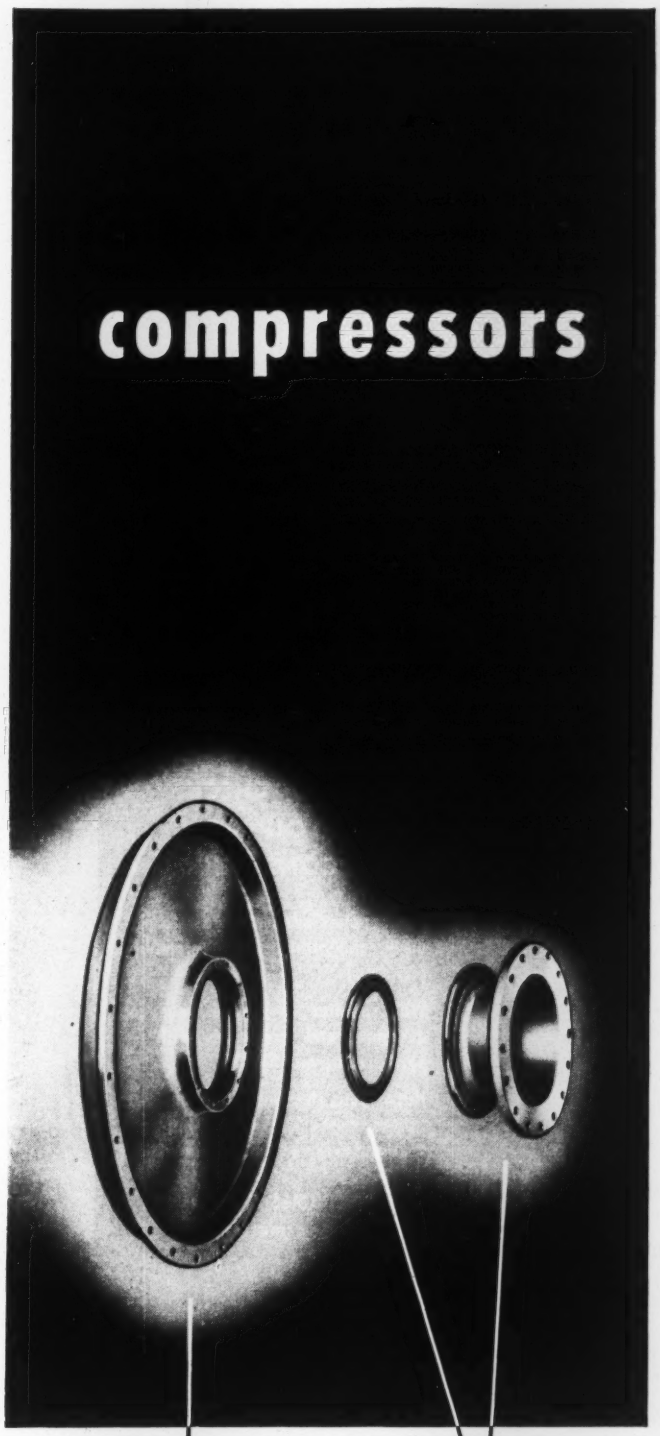
Spacer Disc

Impeller—Shrouded, single-piece, heat-treated, cast-aluminum alloy construction. Statically and dynamically balanced. Overspeeded to 20% above maximum operating speed before assembly.

Shaft Nut

Volute Casing — Cast-iron construction. Bolts with dowel fit to backplate. Twenty-four casing positions available in either direction of rotation.

Serving home and industry: **AMERICAN-STANDARD • AMERICAN BLOWER**


compressors

Suction Cover—Cast-iron suction cover forms outer wall of diffuser passage and bolts with dowel fit to volute casing.

Annulus Packing—Permits accurate alignment with impeller during assembly. **Inlet Nozzle**—Provides uniform gas distribution. Flanged for standard pipe connections.

Designed for

EFFICIENCY

Built for

DEPENDABILITY

American Blower Single Stage Centrifugal Compressors offer several outstanding design features.

For example, the improved scroll design and deep diffuser passage efficiently convert velocity energy into pressure. Labyrinth annulus packing minimizes recirculation of gas around impeller inlet. Aerodynamic design of impeller blade inlets results in high efficiencies and dependable performance.

Before shipment, each compressor is thoroughly tested in accordance with A.S.M.E. Power Test Code for Centrifugal Compressors and Exhausters.

American Blower single stage units are available in sizes from 30 to 600 HP with pressures from 1¼ to 3¾ lbs. For technical data consult the nearest American Blower Branch Office or write us for Bulletin 109.

Whether you need equipment for heating, cooling, ventilating, air conditioning, vapor absorption, fume removal, dust collecting, mechanical draft, heat transfer or smooth power transmission thru Gyrol Fluid Drives — American Blower manufactures a complete line of products to meet your requirements. Helpful technical literature is available on each product.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
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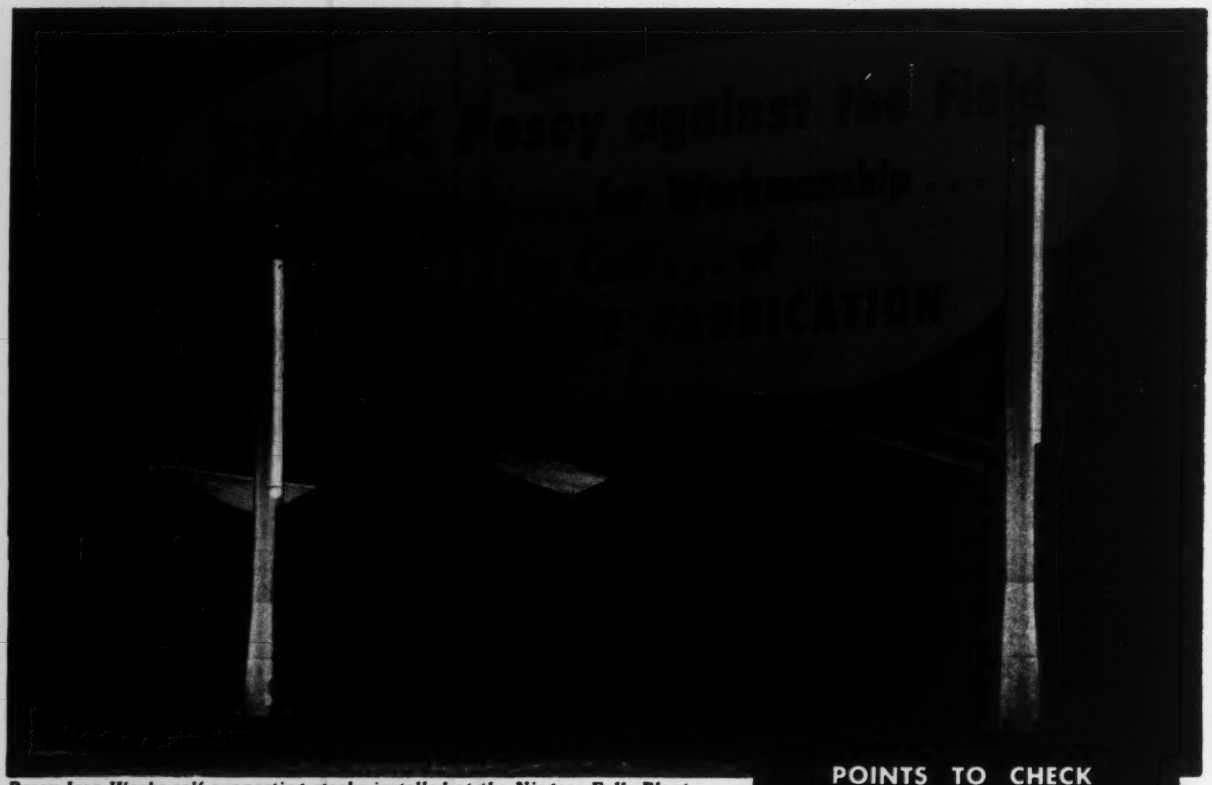

Posey Iron Works self supporting stacks installed at the Niagara Falls Plant of the International Graphite & Electrode Division of Speer Carbon Co. Height: 50 ft. Diameter: 3 ft.

Posey Iron is really "stackin' 'em up" for industries large and small. Stack buyers find that stacks by Posey Iron are sound in workmanship . . . competitive in cost . . . and delivered on date of promise.

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POINTS TO CHECK BEFORE YOU BUY STEEL PLATE CONSTRUCTION

1. Has supplier adequate plant to produce job without costly fumbling and delays?
2. Will supplier assign to your job designers and executives with experience in your field?
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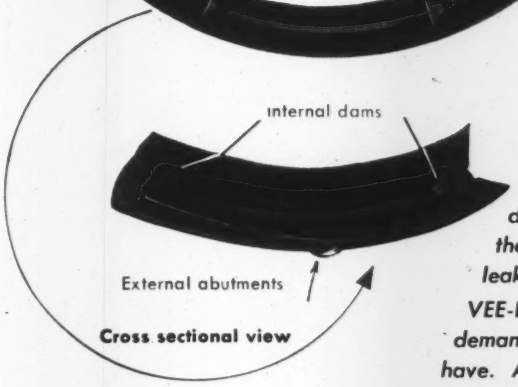
Greatest Giant
in Lockheed Aircraft's
"Hall of Giants" is this 8000-ton
Birdsboro deep-draw press...
the largest of its type in the world.
Its big main rams, in keeping with
their advanced design, are sealed
with LINEAR VEE-DAM Rings,
the most effective modern hydraulic
packing ever developed!

Foolproof to assemble
Leakproof in operation

LINEAR VEE-DAM RINGS



Cross sectional view

The unique design of LINEAR VEE-DAM Rings makes possible, for the first time, a split "V" ring packing that is really leakproof . . . ideal for hydraulic presses, pumps and pneumatic equipment.

A look at the close-up view of a VEE-DAM Ring will tell you why they seal so effectively. Those sturdy rubber dams, faced in opposite directions, are moulded into the groove hinge area of the ring, completely eliminating leakage between rings.

VEE-DAM Rings are easier to install because they don't demand the precise fitting that ordinary rings should have. And they last longer, too, because they seal perfectly tight with a minimum gland load.

Made of a choice of fabric reinforced synthetic rubbers, LINEAR VEE-DAM Rings are individually engineered for your application. Write or call LINEAR for complete information.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

His M-1 Jammed!

Corporal
Rodolfo P. Hernandez, U.S. Army
Medal of Honor

0200 HOURS! Suddenly the pre-dawn blackness on Hill 420 split into crashing geysers of orange flame. Behind the barrage, yelling, firing, hurling grenades, a horde of Reds pushed up the hill toward G Company's position.

A hot fire fight began. It lasted several hours. Finally, suffering heavy casualties, G Company began to withdraw. Corporal Hernandez stayed, throwing grenades and firing his remaining rounds.

Then his M-1 jammed, with a ruptured cartridge in the breech. Fixing his bayonet, he leaped out of his foxhole and disappeared in the darkness toward the attacking Reds. They found him in the morning, wounded, ringed with enemy dead. But he had stopped the attack—*alone*.

"A man couldn't fight at all," says Corporal Hernandez, "if he weren't fighting for good things—peace, and a job, and a chance in the world. That's why I'm thankful to all the people like you who've put so many billions into Bonds. Bonds help fight Commies, sure. But they're also a stockpile of prosperity—for you; for our country. A guarantee to men like me that we can come home to a secure future."

★ ★ ★

Now E Bonds pay 3%! Now, improved U.S. Series E Bonds start paying interest after 6 months. And average 3% interest, compounded semi-annually when held to maturity. Also, all *maturing* E Bonds automatically *go on* earning—at the new rate—for 10 *more* years. Today, start investing in United States Series E Defense Bonds through the Payroll Savings Plan where you work. You can sign up to save as little as $2.00 a payday if you wish.

Peace is for the strong! For peace and prosperity save with U.S. Defense Bonds!

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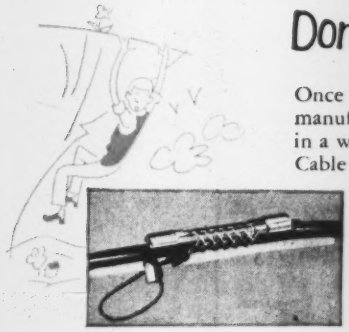
ANACONDA METALS AT WORK

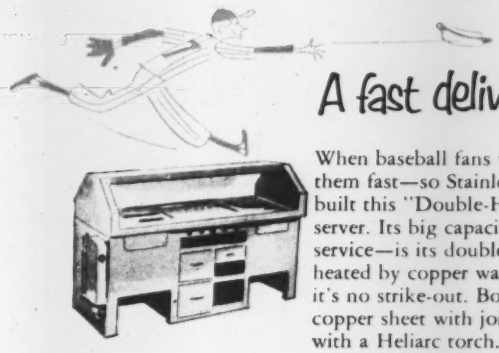
Meet the educated screw

This is a whole family of screws, known as Screwsticks, and joined head-to-toe. Insert a Screwstick in the driver, aim it at the hole—and from there on the Screwstick tightens itself to the predetermined torque, shears itself and gets its head burnished by the following screw which automatically advances itself. It's so fast that American Screw Co. of Willimantic, Conn., which uses ANACONDA Hexagon Brass Rod, refers to it as "jet propulsion".



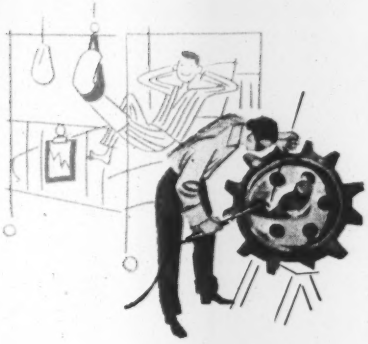
Don't lose your grip

Once a novelty trick developed by the Chinese, the manufacture of these grips is now an industry. Made in a wide variety of styles and sizes by Economy Cable Grip Co. of Norwalk, Conn., they are used to anchor suspended electric power cables and to seize the end for pulling through ducts. The harder you pull, the tighter they grip. Needless to say, the ANACONDA Bronze Cable, Everdur* Rod and Copper Tube used in their manufacture never weaken from rust.



A fast delivery...with mustard

When baseball fans want their hot dogs, they want them fast—so Stainless Alloy Fabricators of Detroit built this "Double-Header" baseball park hot dog server. Its big capacity for hot dogs—and fast service—is its double bun warmer, one at each end, heated by copper water boilers. If the water runs dry, it's no strike-out. Boilers are made of phosphorized copper sheet with joints formed by fusing the edges with a Heliarc torch. No solder used, no seams to burn open.



How to treat a fracture

A fracture often means long uselessness—but that needn't be true of machinery. Usually braze welding can make it good as new and at a fraction of the time and cost of replacing it. This fractured cast iron conveyor drive sprocket, for example, would have taken two months to replace. The Universal Welding Co., Rochester, N. Y., repaired it in only 7 hours by braze-welding with ANACONDA-997 (Low Fuming) Bronze Welding Rod. Moral: don't count the patient out before consulting your welder.

There's more to this than meets the eye

In our Technical Department you will find a range of experience that covers the entire field of copper and copper-alloy applications in the metalworking industries. If you have a problem of metal selection, we are at your service. *The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

*Reg. U. S. Pat. Off. 6391

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CAPACITY FROM 300,000 to 7,500,000 B.T.U. per hour

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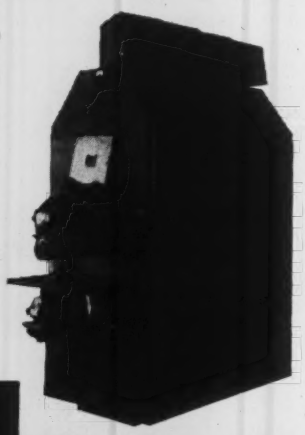

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Gas, Oil, Coal or Dual Gas and Oil

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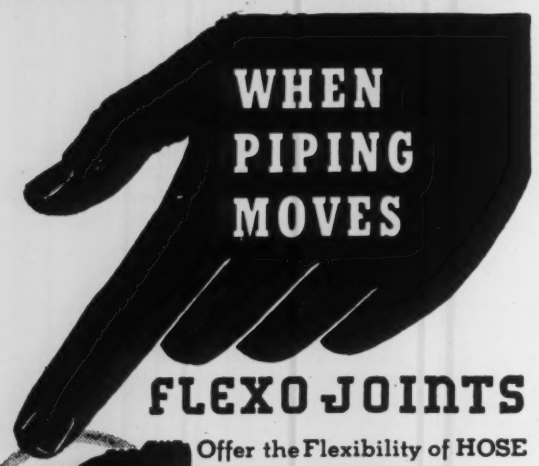
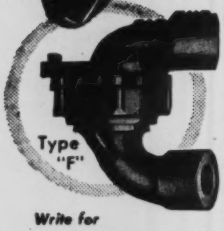
BROAD STREET, CANFIELD, OHIO



WHEN PIPING MOVES

FLEXO JOINTS

Offer the Flexibility of HOSE the Strength of PIPE



For conveying pressures through moving pipe lines or to machinery or equipment while in motion, use dependable Flexo Joints. Complete 360° movement in either direction for pressures from gravity up . . . long wear—low maintenance cost. Four styles—standard pipe sizes ¼" to 3".

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The Hughes Laboratories, located in Southern California, are presently engaged in the development and production of advanced radar devices, electronic computers and guided missiles.

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Opportunities are offered for men who will perform interesting work on development of intricate new devices in close association with outstanding scientists. Activities embrace a variety of challenging problems which require originality and afford unusual possibilities of progress in learning.

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Working experience in advanced techniques employing the above fields will increase your value to the Company as it further expands in development of electro-mechanical devices. Large-scale use of electronically controlled systems in business and industry is a certainty within the next few years.

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Write today to address below, giving details of qualifications and experience. Assurance is required that any relocation of an applicant will not cause disruption of an urgent military project.

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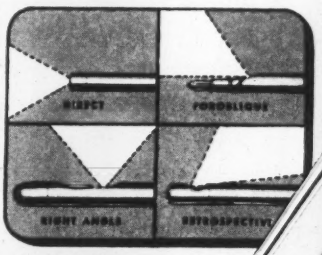
CULVER CITY | LOS ANGELES COUNTY, CALIFORNIA

A.C.M.I. BORESCOPES

for close-up visual inspection of internal surfaces and hidden parts



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American Cystoscope Makers, Inc.
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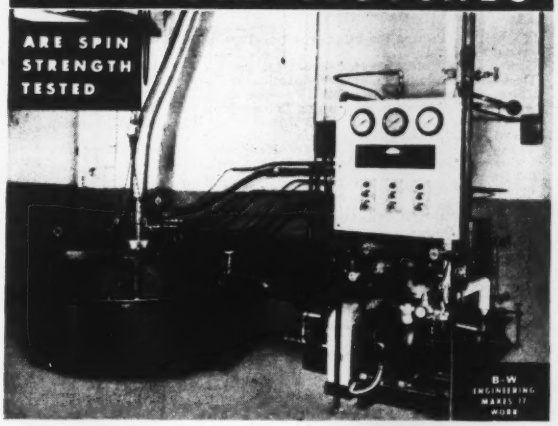
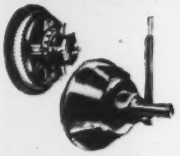


To determine the bursting speed of ROCKFORD CLUTCHES, they are spun up to a high R.P.M. in this air turbine speed chamber. This test assures they will continue to perform efficiently at the speeds for which they were designed. Let ROCKFORD engineers devote the benefit of this and many other tests to *your* product's clutch design.



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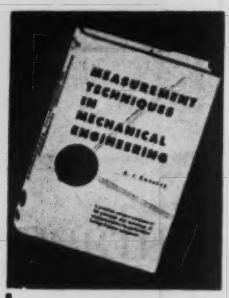

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Consulting Engineer, Formerly Director of the Mechanical Engineering Laboratory, Lehigh University

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Sweeney's book provides a working understanding of the *whys* behind the *hows:* it gives the theoretical background behind measurement principles and errors, as well as the principles upon which the design and operation of instruments are based. It gives seldom found methods for estimation of error in temperature measurement, and presents interesting possibilities for instrument design projects which have not been offered in other books. Application of theory to practical problems encountered in testing work is stressed throughout.

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Most certainly there is one of "our own alloys," or one of the many non-ferrous alloys we make that will meet your exact requirements—At any rate, our long and varied experience as Metallurgical Engineers and Founders is at your service for any problem or product you may have.

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The American Society of Mechanical Engineers
29 West 39th Street New York 18, N. Y.

MECHANICAL ENGINEERING

August, 1953 CARD INDEX Vol. 75, No. 8

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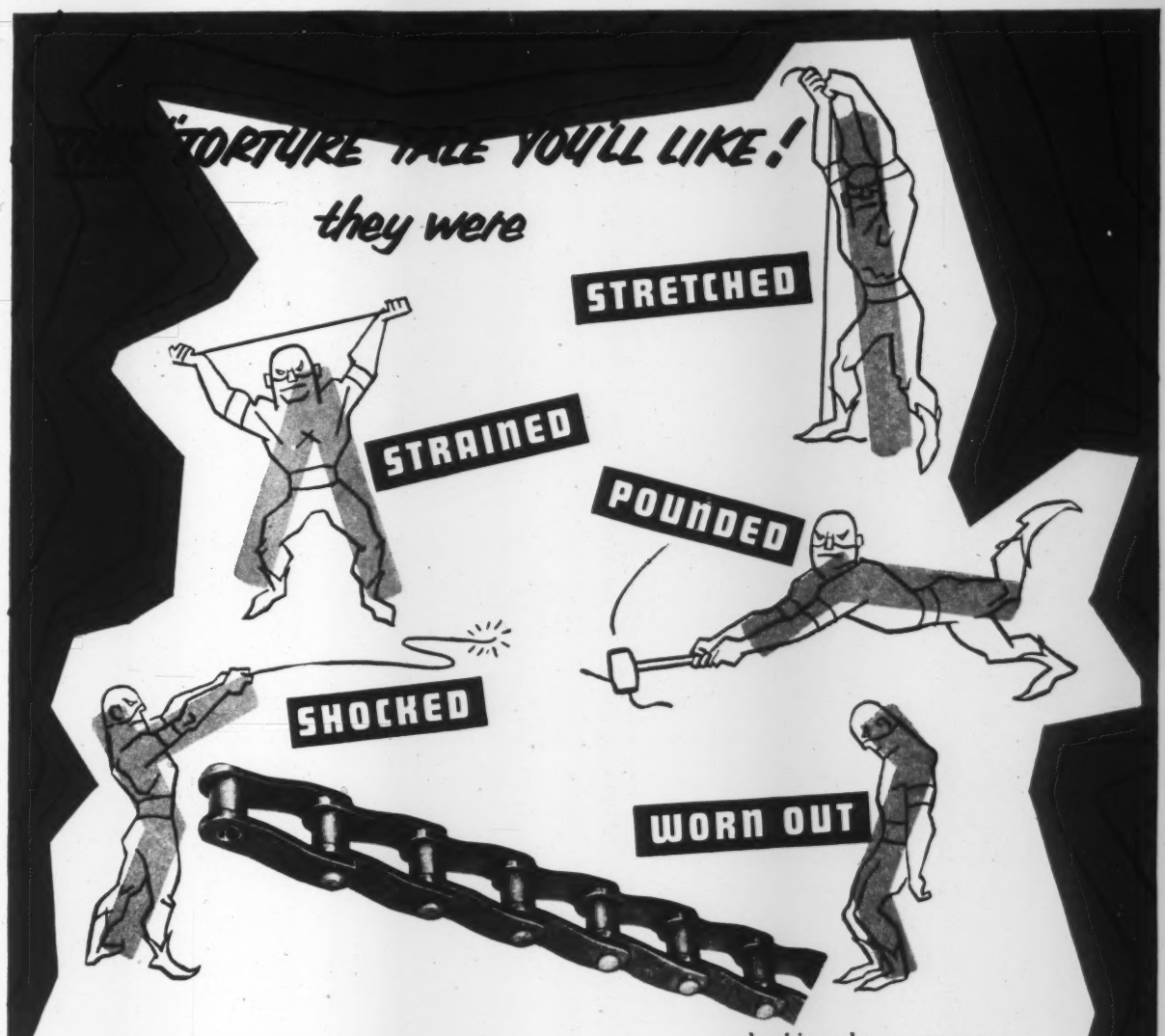

...and subjected to every conceivable test that a modern engineering "torture chamber" could devise. From it came a great new line of improved Rex Chabelco Steel Drive and Conveyor Chains. It wasn't easy because, as Chabelco users know, the previous Chabelco Chains were "tough," strong...hard to beat. But by making a few important design and manufacturing changes, Rex engineers produced a line of improved standard drive and conveyor chains. We call them Rex Chabelco "R" Series Drive and "RR" Series Conveyor Chains! You'll call them the best chains you've ever used!

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Distributors located in principal cities in the United States and abroad
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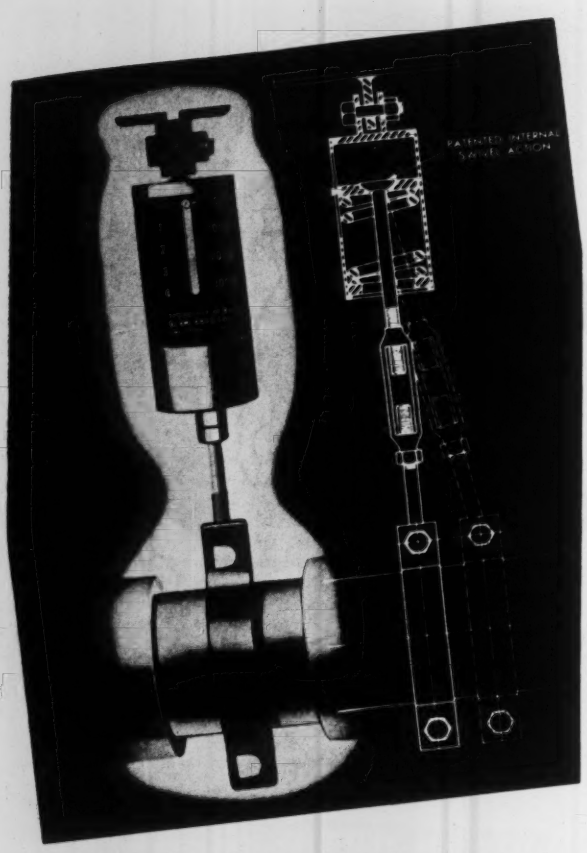

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To save engineering time and eliminate expensive cutting, threading and assembling in the field, just specify—

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Whether the installation calls for Rigid Hanger Assemblies, Functional Hangers, Vibration Eliminators or Overhead Roller Assemblies, you'll find each furnished as a complete unit designed to do the best job. Blaw-Knox pioneered in this field and has brought to it many improvements in hanger design—including the patent Internal Swivel Action which permits both lateral and longitudinal movement, while the hanger case itself remains vertical. Engineers who have solved some of the toughest hanger problems are available at all times to apply their experience to any installation that presents difficulties.

For complete technical data and time-saving information on hanger locating, send for Catalog No. 51.

BLAW-KNOX COMPANY
POWER PIPING AND SPRINKLER DIVISION
PITTSBURGH 33, PA.

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What Features do YOU WANT in a Universal JOINT?

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LOVEJOY HAS THEM ALL!

Available in 13 standard sizes—diameters ½" to 4"—bores ¼" to 2"—lengths 2" to 10⅝"

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Millions of tiny alumina "bubbles" help block heat loss through this . . .

New Castable Cement—Good to 3100 F

Here's a castable cement that is also *one of the most refractory materials available.* Consisting of pure alumina bubbles and highest grade calcium aluminate, it is inherently inert, chemically stable, and will withstand temperatures up to at least 3100 F with practically no shrinkage. It is unaffected by furnace atmospheres and combustion gases. The hollow spheres of alumina make the cement one of the best insulating refractories for really high temperature work. It also follows that it is light in weight, and has low heat capacity.

These ALFRAX® BI aluminum oxide cements (there are actually three types) are particularly easy to install. You just mix with water and pour—like Portland cement. Linings can be put in with a minimum of labor and down time. And, once in, they stay in, even under conditions that quickly destroy other refractories.

For example, one manufacturer lines high temperature ducts (that are sometimes run at over 3000 F) with 3″-thick MULLFRAX® electric-furnace mullite shapes, and backs these up with 8″ of ALFRAX BI cement. Cement shrinkage is practically nil, even at these temperatures. The cement stays free of cracks, and makes a durable monolithic lining that prevents seepage of high-pressure gases.

You have to experience comparative results to believe them. For full data on these castable cements and on other super refractories by CARBORUNDUM, use this handy coupon.

CARBORUNDUM
Registered Trade Mark

Dept. P-93, Refractories Division
The Carborundum Company
Perth Amboy, N. J.

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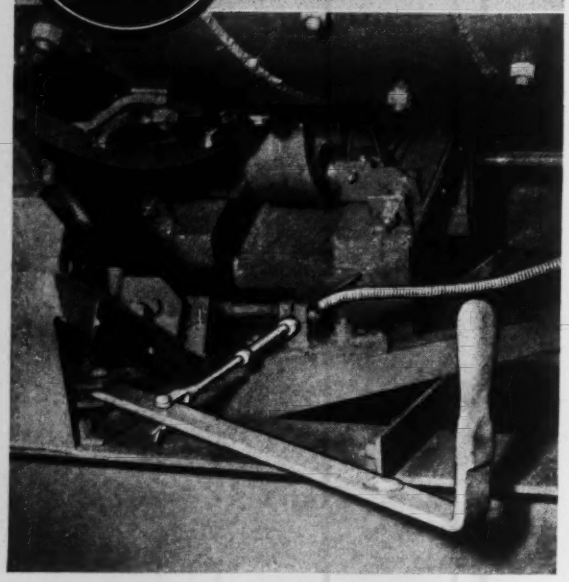
TRU-LAY PUSH-PULL CONTROLS



Snake into Tight Spots

• The TRU-LAY Push-Pull Control illustrated above is on a No. 835 Barber-Greene hot mix dryer. The outside control lever is readily accessible and the PUSH-PULL snakes around obstructions into a tight spot where it engages a clutch.

Flexibility of TRU-LAY Push-Pulls makes them easy to install. This is but one of hundreds of examples of how TRU-LAY Push-Pulls can eliminate the time you would spend designing, making and installing complicated rigid parts. Push-Pulls are ruggedly built, carry their own lubrication and are sealed against dirt and moisture. Capacities up to 1000 pounds input.

If you have a problem in remote control, write our Detroit office today for a copy of DH-287

TRU-LAY PUSH-PULL CONTROLS

ACCO

AUTOMOTIVE AND AIRCRAFT DIVISION
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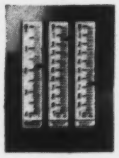

Unit mechanism—readily accessible or removed. Non-parallax pointers. All diafram types have free-floating, long-life diafram. Bell type gages, Bulletin 122—Diafram type, Bulletin 124.

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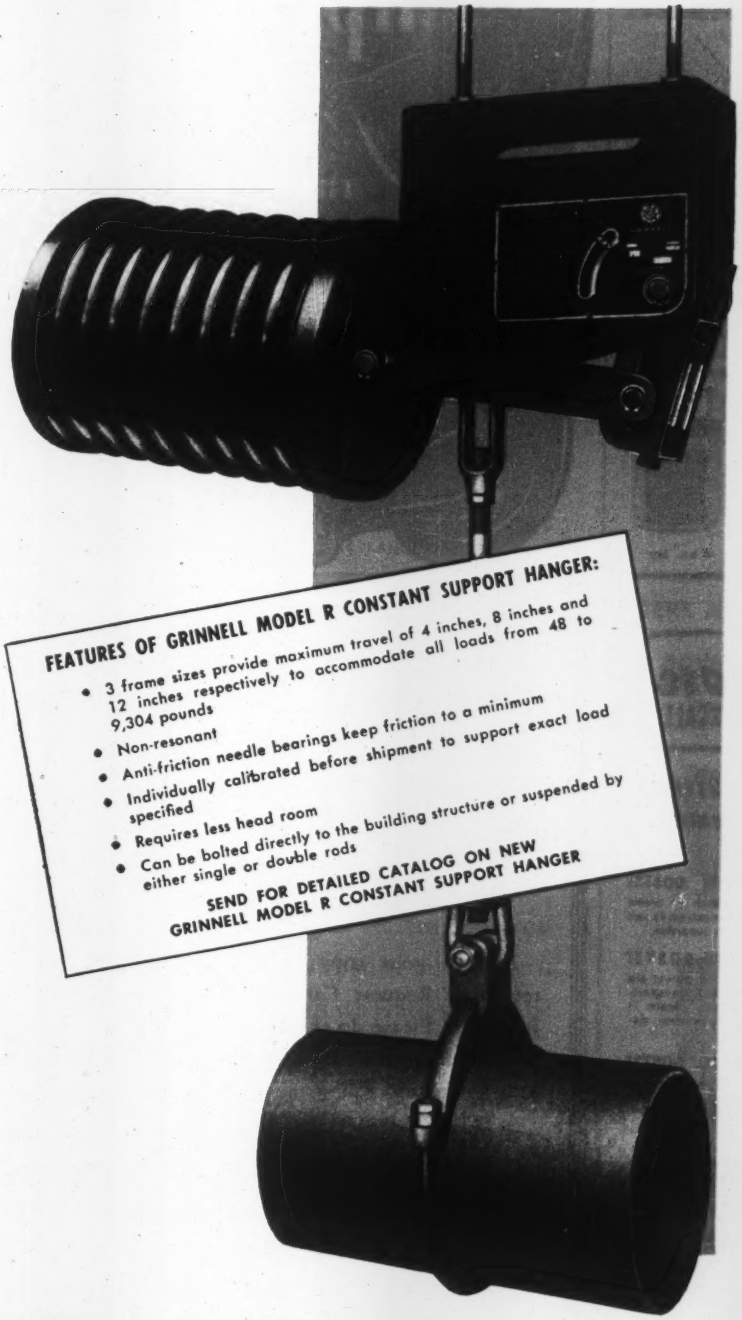
The New GRINNELL MODEL R CONSTANT SUPPORT HANGER



FEATURES OF GRINNELL MODEL R CONSTANT SUPPORT HANGER:

- 3 frame sizes provide maximum travel of 4 inches, 8 inches and 12 inches respectively to accommodate all loads from 48 to 9,304 pounds
- Non-resonant
- Anti-friction needle bearings keep friction to a minimum
- Individually calibrated before shipment to support exact load specified
- Requires less head room
- Can be bolted directly to the building structure or suspended by either single or double rods

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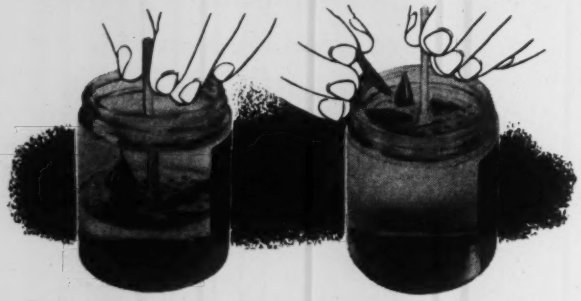

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NON-VOLATILE • HARMLESS TO HANDS, CLOTHING, PENS AND INSTRUMENTS

6 oz. jar

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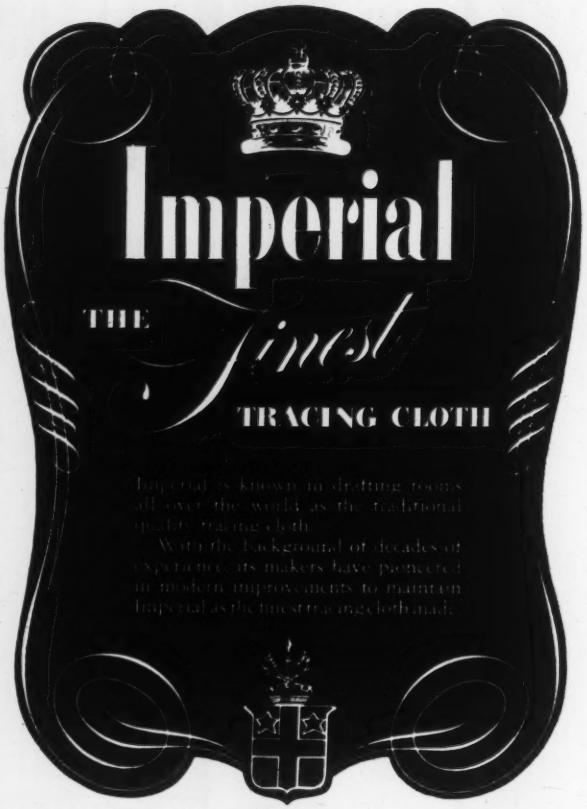

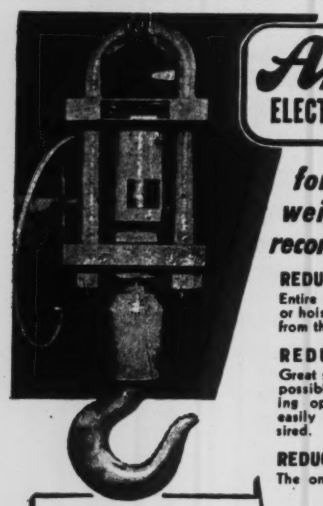

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REDUCES INSTALLATION COSTS!
Entire assembly ready to attach to crane or hoist. Only a cable connection is run from the Load Cell to remote recorder.

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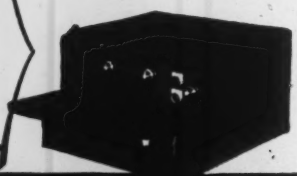

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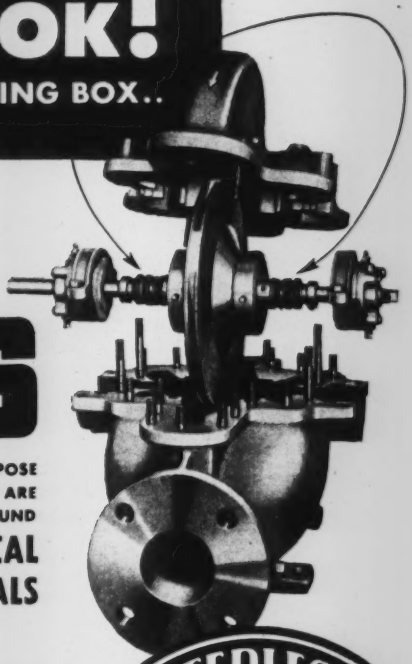

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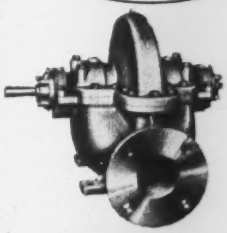

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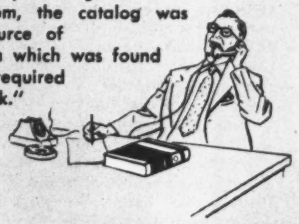

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Additional Opportunities are offered in the display advertisements—on pages 61, 90, 96, 126, 135

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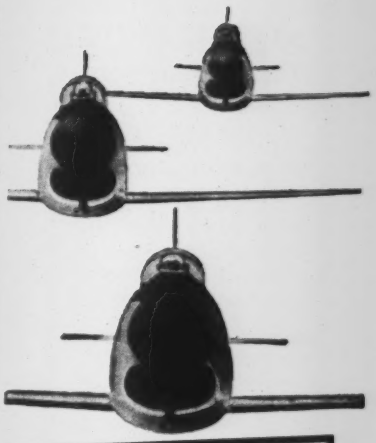

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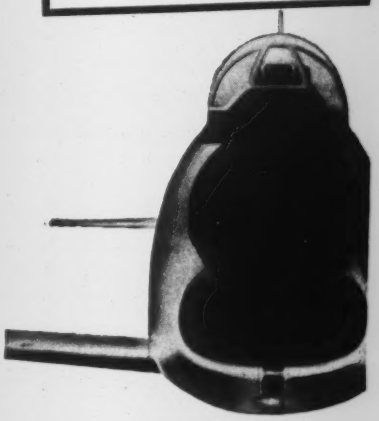

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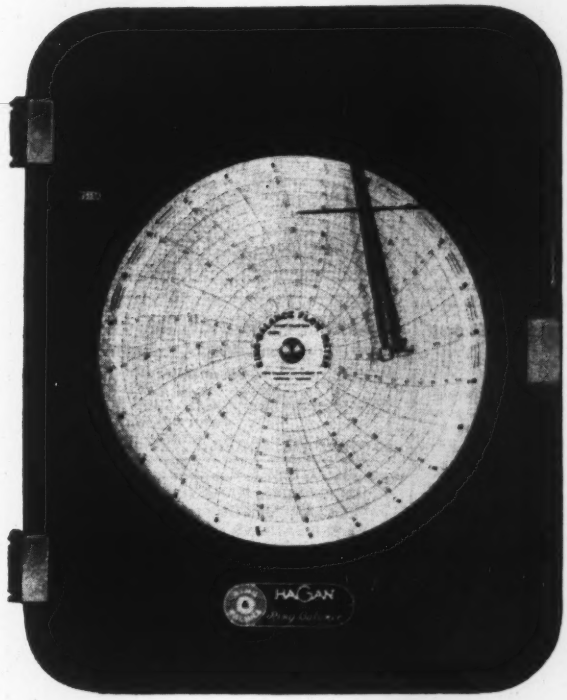

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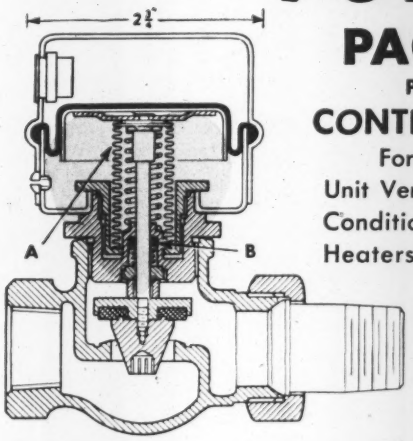

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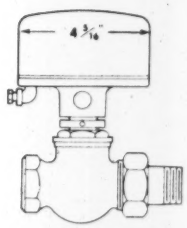
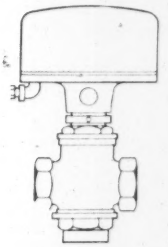
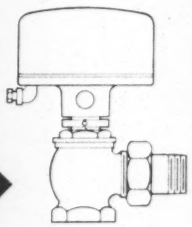
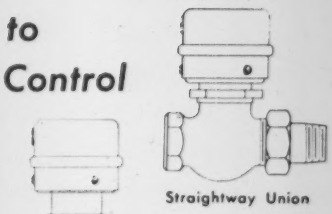


Straightway Union
3-Way Screwed Ends





Angle Union



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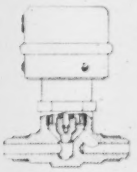
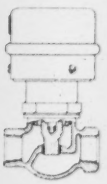
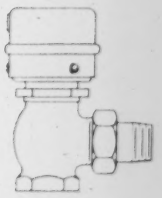


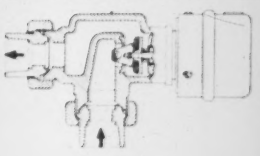
Flared Ends





Angle Union
Screwed Ends

Below: Reverse Flow Double Union



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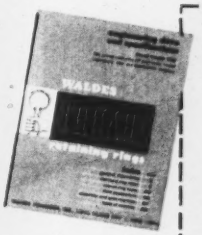
WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.



Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog. ME 095

(Please print)

Name.....

Title.....

Company.....

Business Address.....

City.....Zone.....State.....

in 25 years....

2,228,460,000,000
cubic feet of air delivered!

without major mechanical difficulty of any kind

EVERY CLARAGE FAN
EVERY CLARAGE WASHER
STILL ON THE JOB!

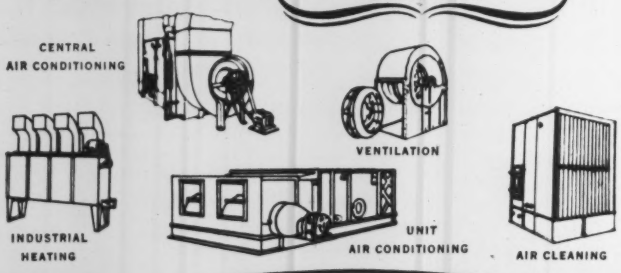
In June 1928, Fidelity-Philadelphia Trust Company, placed in operation its Clarage equipment —40 fans and 4 air washers.

Today the same 40 Clarage fans and the *same* 4 Clarage washers provide efficient, dependable ventilation for this great office building —and they are apparently good for another quarter-century of service.

In handling over two and one quarter trillion cubic feet of air, not a single replacement has been made, nor a single major mechanical difficulty encountered.

Thanks to adequate maintenance on the part of Fidelity management, this Clarage equipment has had the opportunity to prove our slogan: **"You can RELY on Clarage"—RELY on Clarage to cost you far less in the long run.**

Write us about your air handling and/or air conditioning needs...CLARAGE FAN COMPANY, Kalamazoo, Michigan.



You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

HERE YOU SEE two old Clevelands on coal conveyor lines in the main city water works pumping station in Cleveland, Ohio. For 38 years these worm gear speed reducers have worked steadily with never a breakdown.

WORM GEARING—universal in its application—affords advantages for almost every power transmission job. Whether you want worm gearing sets or speed reducer units, you will find drives to meet your need in the complete Cleveland line.

CLEVELANDS give 38 years of continuous service

THESE two Cleveland veterans have been driving coal conveyors for 38 straight years—at least 6 hours each day. The place: City of Cleveland's Division Avenue Pumping Station.

Since 1915 these Cleveland worm gear speed reducers have moved nearly 2 million tons of coal and unnumbered tons of ashes. Each drive has outlasted two motors. They have survived several plant fires. Yet, there has been no major replacement of parts for either drive. Here's why:

Since 1912, Cleveland has concentrated its engineering know-how on the manufacture of one product—worm gearing. Case hardened steel worms, long wearing, low friction bronze gears, and rugged dust-proof and moisture-proof housings are designed and built to give year-after-year dependability under severest operating conditions.

Be sure you specify Cleveland when you want a long wearing right angle drive. Get further data by writing today for new Catalog 400. The Cleveland Worm and Gear Company, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

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26 types and 5,850 sizes —as near as your telephone

EVERY so often, a machinery maker comes to the Timken Company for help with a very special bearing application. Something, he's pretty sure, we've never encountered before.

Almost always, we're able to give him a pleasant surprise. In over 50 years of helping manufacturers with special bearing problems, all the while improving our designs, we've produced an astonishing variety of tapered roller bearings. So many sizes and shapes that the "new" bearing has usually already been designed and made by the Timken Company. So many that the "new" design problem has usually been already solved with the help of Timken Company engineers.

If the people who buy the machines ever have occasion to replace a Timken® bearing, they get the same kind of pleasant surprise. Even when a machine's very old, they can almost always get immediate delivery on Timken bearings for replacement.

Be sure that every bearing you use in the machines you buy or build is stamped with the trademark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN *TAPERED ROLLER BEARINGS*

TRADE-MARK REG. U. S. PAT. OFF.

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ↓◯↑ AND THRUST →◯← LOADS OR ANY COMBINATION →✳◯✳←